Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

April 21, 2010

RECEIVED
WITHOUT PREJUDICE & VERIFYING THE CONTENTS
DATE: 25/04/10 SIGNATURE:

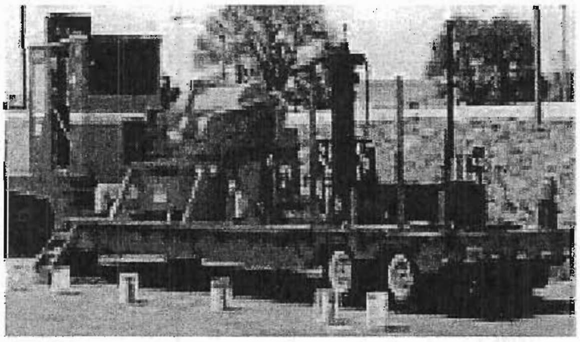
Kuwait Oil Company KSC
Commercial Affairs Group
Team Leader Contracts
Ahmadi – Kuwait

Subject: Pre-qualification 06/05 for Waste Management Services

Dear Sirs:

Enclose herewith is a company Pre-qualification Submission. **We are Kuwait owned American environmental company with a particular specialization, in recovery of usable oil from oily sludge pits, tank bottom cleaning, and oil-contaminated soil remediation**. We use patented technology in our processes. We are respectfully requesting consideration to be pre-qualified with the Kuwait Oil Company.

Our company utilizes a patented "Three-Phase Centrifuge system", which is mounted on a 40' "low-boy" trailer, includes the three-phase centrifuge (with solids trough), an electric process heater, a vapor recovery unit, a control cab (with a personal-computer-based automation system), feed & oil & water tanks, and various piping, pumps, motors, and electrical panels. Centech also utilizes a 28' trailer for decontamination, laboratory, and office functions.



Centrifuge on low-boy trailer with electric heater, vapor recovery unit and control cab and other pumps, piping, motors and electric panels, among other things

Decon-trailer used for decontamination, laboratory and office functions

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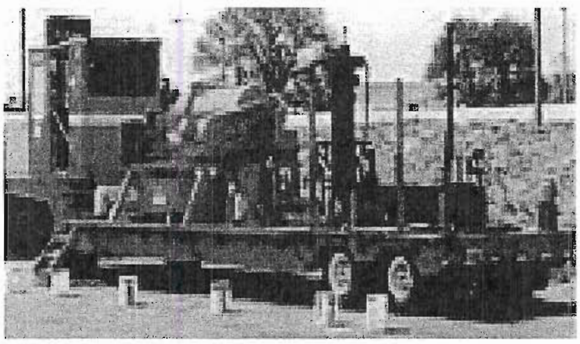

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Centrifuge on low-boy trailer with electric heater, vapor recovery unit and control cab and other pumps, piping, motors and electric panels, among other things

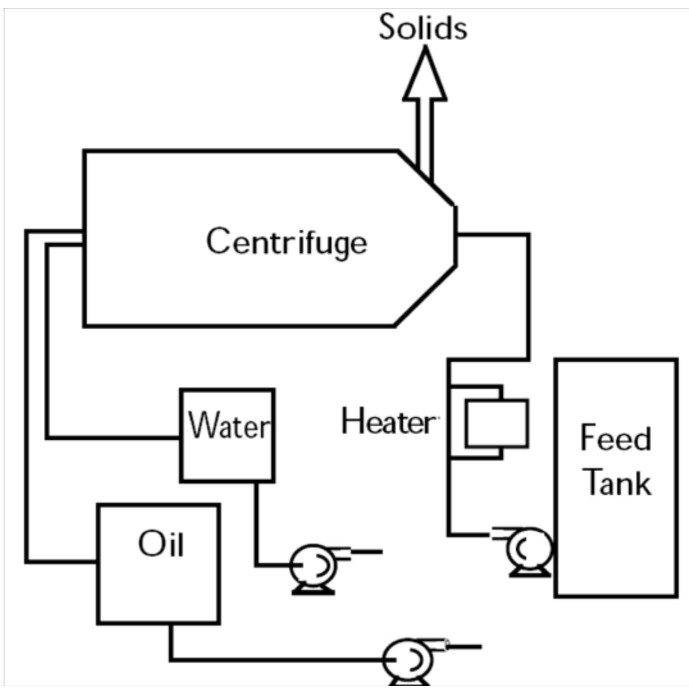

Decon-trailer used for decontamination, laboratory and office functions

Centech International LLC

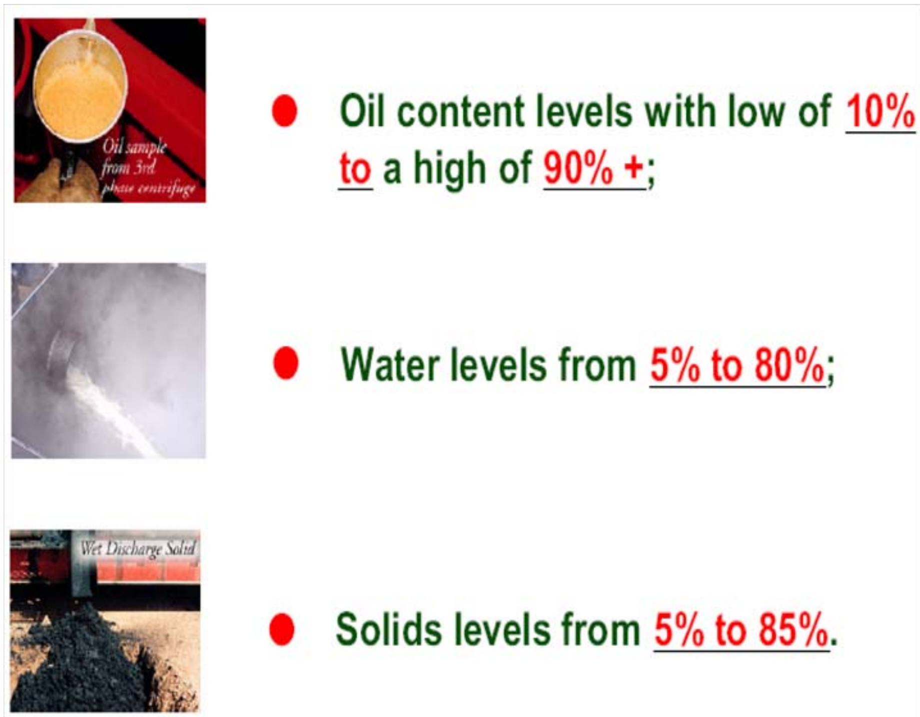
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

Our technology and experience are mature, more than 20 years old. **Centech was purchased by Oil Field Technologies & Environmental Services, WLL (OTES), a Kuwaiti owned and registered company.** The purchase occurred in 2007 and consisted of sole and complete ownership of Centech's assets, know-how and intellectual property. Additionally, Centech's intellectual property inventor and original staff are contractual obligated to OTES as a part of the purchase agreement. Accordingly, our parent company has issued in the Appendix to our submission a Parent Company Guarantee.

Below is a simple flow diagram of our three phase processes:



Thermal and chemical techniques, alone or in combination, may drive off any light components and leave behind an even more difficult oil-chemical-water-solids mixture presenting and even more difficult separation problem. We try to avoid the use of thermal and chemical techniques as our patented process allows us to deal with the widest variety of oil field waste mixture, usually consisting of oil, brine, and solids without them. Independent testing and results with our customer demonstrate our ability to separate oils with levels of processed emulsion ranging from:



In the past 20 years, our company including our current managerial, operational and technical staff have successfully recovered saleable oil from sludge pits and tank bottoms for a wide variety of major oil companies and independent oil companies, including ***Chevron, Conoco, Marathon, Texaco, Amoco, Phillips, Unocal and Encana***. In one event we were even selected by the United States Environmental Protection Agency to perform an environmental oil sludge pollution cleanup at Powder River as ordered and supervised by a United States Federal Court. This experience is detailed in Section 3 – Applicant's Previous Experience.

Our technology and experience in recovering salable oil with a BS&W consistently less than 1% is verifiable by our customers. In addition, this fact has been previously verified by the test results of various United States governmental and independent entities by whom we have been tested.

For example, the ***Rocky Mountain Oilfield Testing Center (RMOTC)*** is a United States Department of Energy facility in Wyoming that partners with service companies and equipment manufacturers to test new ideas and products leading to increased recovery or reduced operating costs. Their report dated 30th March 1998, concluded that our equipment operated successfully and reliably, broke the intended emulsions, produced salable oil and operated in hands off mode.

Los Alamos National Laboratory, a part of the United States Department of Energy's National Nuclear Security Administration, believes that oil sludge pollution is such a challenging problem requiring multi-disciplinary research for solution. Los Alamos therefore entered into a Cooperative Research and Development Agreement (CRADA) with our predecessor company to develop a dedicated and intelligent control system to be used with our three-phase centrifuge. As a result of this cooperation, our company jointly with Los Alamos, were granted patent number 6,860,845 in March 2005 from the United States Patent & Trademark Office. The cooperative work and results of the CRADA are detail by a senior Los Alamos researcher, J. W. Parkinson, **Three – Phase Centrifuge Technology or Minimizing Petroleum Waste**, in the newsletter "Eye on Environment", a publication of the United States Department of Energy's Oil & Gas Environmental Research Program in the June 1997, Volume 2, No. 2, issue.

Our company's original patent for its equipment from the United States Patent & Trademark Office was granted under patent number 5,156,751 in October 1992.

The ***National Energy Testing Laboratory (NETL)*** is a part of the United States Department of Energy's national laboratory system. NETL was interested enough in our three-phase centrifuge technology to fund long-term research from June 1999 through December 2005. The results of that research was the enhancement of our technology's commercial viability by the maturation of an expert set up and control, "fuzzy Logic"system.

Centech International LLC

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Annually millions of barrels of oily sludge waste are created from sludge pits, oil-contaminated soil, storage tank bottoms and refinery waste, among other sources. Improper and/or inadequate disposal processes of the aforementioned conditions result in a very serious and negative environmental impact. Thus wasting a national energy resource.

We respectfully request, that you give us the opportunity to help you solve your oil field waste management problems using proven technology that is Kuwaiti owned. We can and will produce for you salable oil while eliminating unsightly, environmentally unfriendly and hazardous oily sludge waste.

Yours faithfully,

Ernest W. Alexander

Ernest W. Alexander, Esq.
Managing Director

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

cc: Mohammed H. Al-Muharreb
Chairman & Managing Director
Oil Field Technologies & Environmental Services Co.

W:\Centech-Product-Inquiry\KOC\New Submission\Cover-2-KOC-PQ-Submission 21 april 2010.wpd

FINAL

CENTECH INTERNATIONAL LLC

PRE-QUALIFICATION SUBMISSION

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

April 21, 2010

To: KUWAIT OIL COMPANY
COMMERCIAL AFFAIRS GROUP
TEAM LEADER CONTRACTS – (I)
AHMADI – KUWAIT

Dear Sirs,

Subject: - **PQ 06/05**
WASTE MANAGEMENT SERVICES

1. We submit our completed pre-qualification questionnaire along with the additional information required and request to be included in the Company's list of approved contractors for the subject Services.
2. We acknowledge that the Company has absolute discretion in the selection of contractors and that the Company is not required to provide any reason not to include our company on the above-referred list.
3. We consent to Company's representatives visiting our offices, facilities and Services progress, as the Company considers necessary to satisfactorily evaluate our application. In the event of such visits taking place, we shall provide whatever assistance necessary to the Company's representatives to assist them in the evaluation of the application.

Name	:	Ernest W. Alexander
Signature	:	Ernest W. Alexander
Name and Title of Authorised Signatory	:	Ernest W. Alexander - Managing Director
Applicant's Company Name	:	Centech International LLC

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

PQ- 06/05

KUWAIT OIL COMPANY (K.S.C.)
(Register of Commerce No. 21835)

PRE-QUALIFICATION
FOR
WASTE MANAGEMENT SERVICES

(PQ- 06/05)
PRE-QUALIFICATION FOR
“WASTE MANAGEMENT SERVICES”

INDEX

KUWAIT OIL COMPANY (K. S. C.)

PRE-QUALIFICATION

FOR

WASTEMANAGEMENT SERVICES

(PQ-06/05)

INVITATION TO PREQUALIFY

Submitted by
Centech International LLC

KUWAIT OIL COMPANY (K.S.C.)
(Register of Commerce No. 21835)

PRE-QUALIFICATION FOR
WASTE MANAGEMENT SERVICES

INVITATION TO PREQUALIFY

1. Introduction

1.1 The Kuwait Oil Company (K.S.C.) hereinafter referred to as the “Company” is a State owned company, which is responsible for extracting crude oil resources from Kuwait’s oil fields and export through its marine terminals.

1.2 The Company is seeking to prequalify “Contractors” referred to as the “Applicants” with proven capabilities and experience in the required Services.

1.3 The result of this pre-qualification exercise will be the development of a new list of contractors, to whom “Invitations to Tender”/”Request for Proposal” for the required Services will be issued.

1.4 All Applicants are required to submit their applications in proper order and as advised by the Company, otherwise will not be considered.

2. Guidelines for Pre-qualification

Subject to the provision that the Company is under no obligation to pre-qualify any Applicant or to give reasons for acceptance or rejection. Applicants shall be pre-qualified if they satisfactorily demonstrate the following to the Company:

2.1 Applicant is capable and prepared to take full responsibility for conducting the required Services to the full satisfaction of the Company.

2.2 Applicant has proven records of completing similar Services as described above, as the prime “contractor” with full responsibility for the entire services. The Applicant must have annual turnover in access of five (5) million United States Dollars and that the Applicant has a record of relevant work over the past ten (10) years.

2.3 Applicant has a current workload, which shows that the Applicant is now active in the same field of the required Services and that this workload is consistent with its current resources, manpower and financial standing, and that additional work of the magnitude being considered by the Company would not overstretch the Applicant’s capability.

2.4 Applicant is currently employing its own personnel and resources, which are of adequate quantity and expertise for a successful execution and completion of the Services. The Applicant will also need to show that it has access to additional personnel and resources if required to boost the Applicant's capability in the event of award of work by the Company.

3. Conditions for Award of Work

Tenders issued by the Company are issued in accordance with the State of Kuwait's Law governing public tenders' number 37 of 1964 and subsequent amendments thereof. This law requires that any tender submitted which is not strictly in accordance with the terms and conditions contained in the Invitation to Tender shall be disqualified. Applicants are therefore advised that only companies who can accept the Company's contractual terms, in full, should apply for pre-qualification. The most important terms are:

3.1 Invitations to Tender require that the tender price is a fixed lump sum of the Contract, not subject to change during Tendering Stage.

3.2 The contractor shall execute the Services on a turnkey basis supplying all materials, plant, labour and Services necessary for timely completion of the Services.

3.3 Time for completion is determined by the Company within the Invitation to Tender. The contractor's tender must be based on that contract period.

3.4 Payment shall be made monthly on the basis of measured progress, submitted by way of an invoice to the Company's Accounts Payable Team. Each payment shall be subject to 5% retention. The total 5% retention will be released to the contractor only upon satisfactorily completing the required Services and its submission of a Tax Clearance Certificate form the Income Tax Office of the Ministry of Finance, Kuwait, indicating that the contractor has discharged its tax liabilities (if any) in full.

3.5 Liquidated damages are applicable in the event of delay beyond the contract completion date. The calculation basis for liquidated damages varies depending on the nature of the Services concerned.

3.6 The contractor insures the Services to its full value with an 'All Risks' insurance policy during the contract period.

3.7 Performance guarantees will be required.

4. Instructions to Applicants

4.1 The Applicant shall complete all parts of the questionnaire and provide information required in English.

4.2 The Applicant shall answer every question in this questionnaire.

4.3 Answers to questions and information supplied must be accurate and unambiguous. Additional pages shall be inserted in the event additional space is needed for replying to the questions. Any additional information that the Applicant wishes to offer should be clearly separated from specific responses within the single bound document to be submitted. Do not include company reports or other handouts of an advertising nature unless they contain relevant and specific information requested in the questionnaire.

4.4 Applicant shall submit one original and one copy of the questionnaire and supporting information. The form and layout of the questionnaire must be adhered to by the Applicant and should all be contained in one single bound volume.

4.5 The Applicant's submittal must be in duplicates marked as Original and Copy, both sealed in two separate envelopes.

4.6 Applicant shall deliver their submittal to the Company as stated in the Official Kuwaiti Gazette (Kuwait Al-Youm) or as advertised in official local or international newspapers.

4.7 Only established companies that are single corporate bodies can be pre-qualified.

4.8 Applicant must apply on its behalf only. Information provided in the questionnaire must be true and correct for the Applicant itself. Information, which incorporates data regarding parent, associate, or subsidiary companies, or subcontractors, or companies to whom the Applicant was subcontracted, must be clearly identified as pertaining to such companies.

4.9 If the applicant applying is a wholly owned subsidiary company part of group of companies, then the application must be for the company who shall actually perform any work awarded and in the location where that work will be performed. However, the applicant shall obtain its parent company's signature and sign on the form included within this Pre-qualification Documents as Appendix – I, namely "Parent Company Guarantee". This guarantee shall grant the technical and financial support from the parent company whenever needed by the Company during the contract's life with the Company.

4.10 No more than one application shall be considered from any group of companies.

4.11 Pre-qualification shall be granted for the Applicant's company only and shall not include Pre-qualification of any parent or sister or subsidiary companies.

4.12 By submittal of an application, the Applicant shall permit the Company to: -

a) Take any steps which the Company considers necessary to audit or verify the information contained in the application, and;

b) Subject to prior notification, visit the Applicant's offices and facilities wherever they may be located.

5. General

5.1 Subject to 4.12 above, the Company will treat all replies in a strictly confidential manner.

5.2 The Company will retain all document submitted by the Applicant for its record.

5.3 The Applicant is advised to submit its prequalification documents in the format offered by the Company along with a covering letter as per the attached letter format duly signed by the authorized person.

5.4 The Company is under no obligation to pre-qualify any applicant or to give reasons either for pre-qualifying or disqualifying any applicant. Nor is the Company obliged to include any pre-qualified applicant on the list of approved tenderers for any other particular project or contract.

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

April 21, 2010

To: KUWAIT OIL COMPANY
COMMERCIAL AFFAIRS GROUP
TEAM LEADER CONTRACTS – (I)
AHMADI – KUWAIT

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Name	:	Ernest W. Alexander
Signature	:	Ernest W. Alexander
Name and Title of Authorised Signatory	:	Ernest W. Alexander - Managing Director
Applicant's Company Name	:	Centech International LLC

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

SECTION ONE

MANDATORY QUESTIONS

SECTION ONE – MANDATORY QUESTIONS

If the Applicant cannot answer affirmatively to all questions in this section, then the Applicant's submission will be rejected.

1. Does the Applicant have work experience in conducting the management of hazardous and non-hazardous wastes based on international regulations?

   (a) Management of hazardous wastes ☑ **Yes** ☐ **No**

   (b) Management of non-hazardous wastes ☑ **Yes** ☐ **No**

2. Does the Applicant have any work experience in applying waste minimization in the above waste handling activities?

   ☑ **Yes** ☐ **No**

3. Does the Applicant have any work experience in conducting Treatment of Wastes in oil production industries based on international regulations?

   ☑ **Yes** ☐ **No**

4. Did the Applicant submit its complete Financial Data as Attachment -6 to Section Five?

   ☑ **Yes** ☐ **No**

5. Is the Applicant's annual turnover in excess of five (5) million United States dollars?

   ☑ **Yes** ☐ **No**

Signature: Ernest W. Alexander

Name: **Ernest W. Alexander**

Name and Title of Authorized Signatory: **Ernest W. Alexander – Managing Director**

Applicant's Company Name: **Centech International LLC**

Applicant's Company Stamp:

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

SECTION TWO

APPLICANT COMPANY'S ORGANIZATION & STRUCTURE

SECTION TWO
APPLICANT COMPANY'S ORGANIZATION AND STRUCTURE

Applicant must complete all portions of the following to clearly indicate its organization and structure.

1. Full Name of Applicant's Company:

   Centech International LLC

2. Name and Title of Applicant Company's officer authorized to enter into correspondence regarding this pre-qualification application:

   Ernest W. Alexander – Managing Director

3. Address for Correspondence:

   P.O. Box 2170, Mills, Wyoming 82644, 3444 Burd Road, Casper, Wyoming 82601

4. Telephone Number (including international code):

   USA (307) 265 7621 Kuwait (965) 22402828

5. Facsimile Number (including international code):

   USA (307) 265 7621

6. E-mail Address / Home Page:

   e.alexander@oteskuwait.com

7. Type of Company (Private Limited Liability, Public Limited Liability):

   Limited Liability Co.

8. Country of Incorporation and Date of Establishment:

   USA – 1987

9. Address of Registered Head Office (if different from 3 above)

Same as 3 above

10. Please confirm or provide the address of Applicant's operational headquarters (if different from 9 above). This must be the office, which will be responsible for, and which will perform project management services.

P. O. Box 2170, Mills, Wyoming 82644

3444 Burd Road, Casper, Wyoming 82601

11. Authorized Capital (US Dollar)

$1,000,000

12. Issued Capital

$500,000

13. Full Name of Applicant's Local Agent in Kuwait (if any)

Mr. Mohammed Hamoud Al Muharreb Al Hamoud
Oil Field Technologies & Environmental Services Co.

14. Address of Local Agent

Oil Field Technologies & Environmental Services Co.

P.O. Box 4464 Safat 13045 Kuwait

15. Telephone Number of Local Agent

(965) 22402828 – (965) 22402929

16. Fax Number of Local Agent

(965) 22404500

Email Address/Home Page of Local Agent
info@oteskuwait.com www.oteskuwait.com
m.almuhareb@oteskuwait.com

17. Is the Applicant a wholly owned subsidiary of a parent company? If so, please answer previous questions 1 through 16 (as **Attachment-1** to this Section Two) on a separate sheet for the parent company. If there is a tier of such parent company, please provide a separate sheet for each company up to and including the ultimate parent company.

    Yes, Oil Field Technologies & Environmental Services Co.
    P.O. Box 4464 Safat 13045 Kuwait.

18. Is the Applicant a subsidiary of two or more holding companies? If so, please answer previous questions 1 through 16 (as **Attachment-2** to this Section Two) for each of the holding companies involved. If any of the holding companies are themselves wholly or jointly owned subsidiaries of other companies, please provide a separate sheet for each company up to and including the ultimate parent companies.

    No.

19. If the Applicant is a subsidiary as stated in 17 above, please state the percentage owned by each of the holding companies:

    Oil Field Technologies & Environmental Services Co. Kuwait – 100%

20. Please state (in general terms) the nature of your core business as indicated by your articles of incorporation and as shown by your contracting history detailed in Section 3 of this questionnaire.

    To recover by mechanical separation oil from sludge, oil accumulated in tanks bottoms, and oil-contaminated soil.

21. Please provide the name, address and facsimile numbers of your primary bankers.

    Centech International LLC. Hilltop National Bank , P.O. Box 2680, 300 Country Club
    Road, Casper. WY 82602. Bank Routing Number 102301199, Account # 1097733
    Tel: (307) 5773408

22. Please provide the name, address and facsimile numbers of your company's auditors.

Larry D. Bailey, 1140 Connecticut Avenue, Suite 500

Washington, DC 20036

Tel: 202 293 1999 Fax: 202 293 6999 Email: ldbailey2002@yahoo.com

23. The present total number of permanent employees on Applicant's payroll is:

"Please provide (as **Attachment-3** to Section Two) the applicants organization chart *including depicting* the relationship of the Applicant to any parent, holding and/ or associated companies."

Signature: Ernest W. Alexander

Name: **Ernest W. Alexander**

Name and Title of Authorized Signatory: **Ernest W. Alexander – Managing Director**

Applicant's Company Name: **Centech International LLC**

Applicant's Company Stamp: EWA

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

SECTION TWO

ATTACHMENT NO. 1

APPLICANT COMPANY'S ORGANIZATION & STRUCTURE

(PARENT COMPANY)

ATTACHMENT 1 TO - SECTION TWO
APPLICANT COMPANY'S ORGANIZATION AND STRUCTURE

Applicant must complete all portions of the following to clearly indicate its organization and structure.

1. Full Name of Applicant's **PARENT** Company:
   Oil Field Technologies & Environmental Services Co., WLL

2. Name and Title of Applicant Company's officer authorized to enter into correspondence regarding this pre-qualification application:
   Mr. Mohammed Hamoud Al Muharrab Al Hamoud – Chairman & Managing Director

3. Address for Correspondence:

   Oil Field Technologies & Environmental Services Co., WLL
   P.O. Box 4464 Safat 13045 Kuwait

4. Telephone Number (including international code):

   (965) 2240-2828 – (965) 2240-2929

5. Facsimile Number (including international code):

   (965) 2240-4500

6. E-mail Address / Home Page:

   m.almuhareb@oteskuwait.com
   info@oteskuwait.com www.oteskuwait.com

7. Type of Company (Private Limited Liability, Public Limited Liability):

   Public Limited Liability

8. Country of Incorporation and Date of Establishment:
   KUWAIT - 2007

9. Address of Registered Head Office (if different from 3 above)

Same as 3 above

10. Please confirm or provide the address of Applicant's operational headquarters (if different from 9 above). This must be the office, which will be responsible for, and which will perform project management services.

Oil Field Technologies & Environmental Services Co.
P.O. Box 4464 Safat 13045 Kuwait

11. Authorized Capital (US Dollar)

$400,000

12. Issued Capital

$400,000

13. Full Name of Applicant's Local Agent in Kuwait (if any)

N/A.

14. Address of Local Agent

N/A

15. Telephone Number of Local Agent

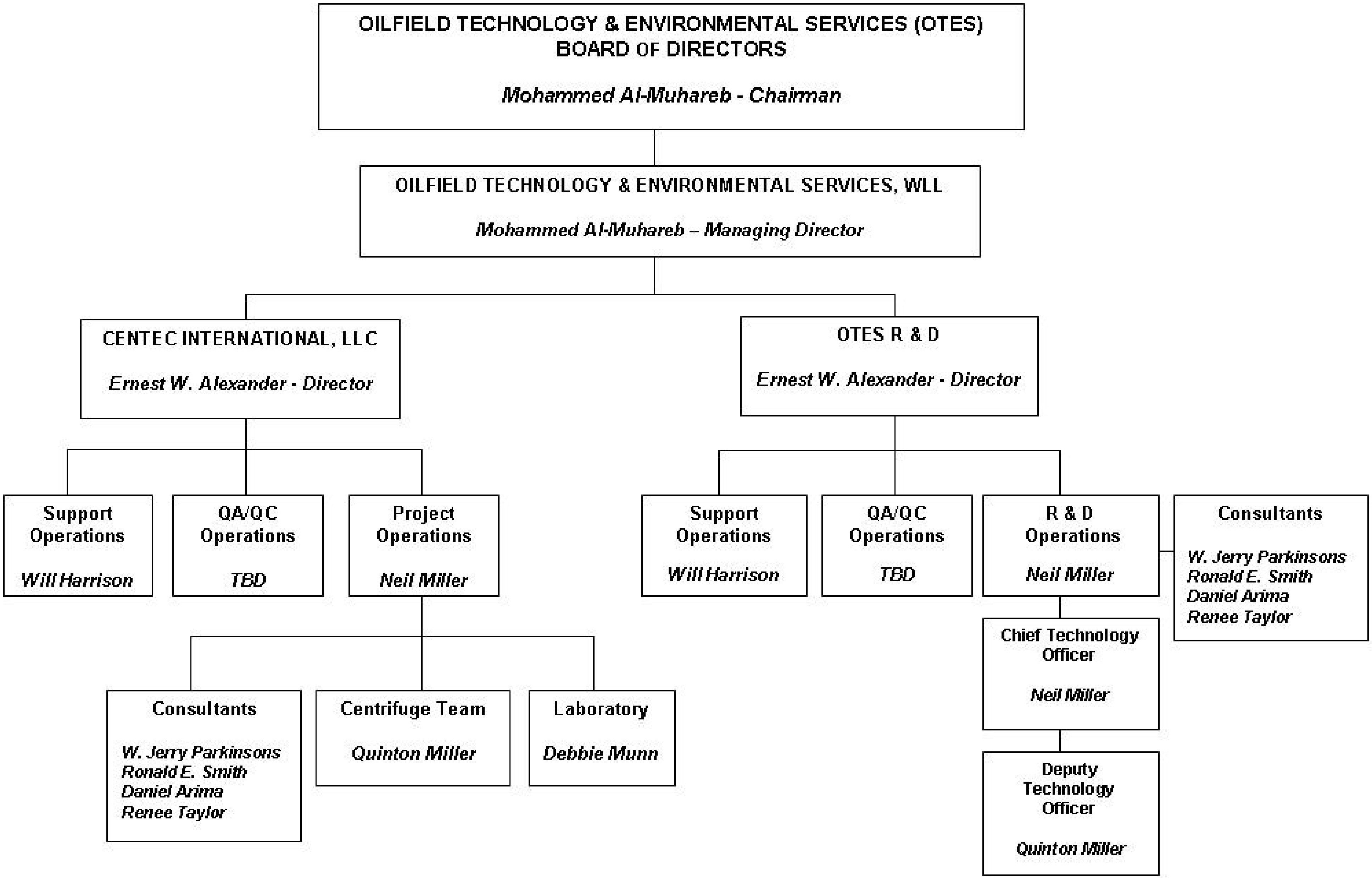
N/A

16. Fax Number of Local Agent
N/A

E-mail Address / Home Page of Local Agent
N/A

SECTION TWO

ATTACHMENT No. 2
ORGANIZATIONAL STRUCTURE


OILFIELD TECHNOLOGY & ENVIRONMENTAL SERVICES (OTES)
BOARD OF DIRECTORS
Mohammed Al-Muhareb - Chairman
OILFIELD TECHNOLOGY & ENVIRONMENTAL SERVICES, WLL
Mohammed Al-Muhareb – Managing Director
CENTEC INTERNATIONAL, LLC
Ernest W. Alexander - Director
OTES R & D
Ernest W. Alexander - Director
Support Operations
Will Harrison
QA/QC Operations
TBD
Project Operations
Neil Miller
Support Operations
Will Harrison
QA/QC Operations
TBD
R & D Operations
Neil Miller
Consultants
W. Jerry Parkinsons
Ronald E. Smith
Daniel Arima
Renee Taylor
Chief Technology Officer
Neil Miller
Deputy Technology Officer
Quinton Miller
Consultants
W. Jerry Parkinsons
Ronald E. Smith
Daniel Arima
Renee Taylor
Centrifuge Team
Quinton Miller
Laboratory
Debbie Munn

SECTION THREE

APPLICANT'S PREVIOUS EXPERIENCE

**TO BE PROVIDED
BY THE APPLICANT**

ATTACHMENT NO. **1– PREVIOUS EXPERIENCE**

ATTACHMENT NO. **2– BEST PRACTICE WASTE MANAGEMENT CHECKLIST**

ATTACHMENT NO. **3– ISO 9001:2000 CERTIFICATE**
ISO 14001:2004 CERTIFICATE
OHSAS 18001 CERTIFICATE

SECTION THREE – APPLICANT'S PREVIOUS EXPERIENCE

1. Attach (as **Attachment No.1** to this Section Three) details of your experience in the Waste Management contracts awarded by major oil/gas companies completed over the past ten (10) years from the Applicant's own operational office (only contracts which were awarded in the Applicant's own name should be listed). Where the contract awarded was a subcontract for a larger contract, or was for a portion of service related to a larger contract, then the relationship and scope of the services performed by the Applicant must be clearly defined and adequate evidence must be submitted so that it is clear that the Applicant was not the prime consultant for that entire contract.

1.1 The Applicant shall provide, as a minimum, full details of the one (1) contract complying with questions (1), (2) and (3) of Section One - Mandatory Questions.

1.2 The following information must be provided for each contract:

- ♦ Name of Client, address, telephone & fax numbers, contact persons and e-mail addresses
- ♦ Title, Location and Type of Contract
- ♦ Applicant's Scope of Service
- ♦ Quantity of waste handled – collected, segregates, transported, recycled, minimized, treated and disposed
- ♦ Contract Price (approximate)
- ♦ Date of Commencement
- ♦ Date of Completion
- ♦ Percentage of contract subcontracted out and the nature of the service subcontracted.
- ♦ If the Contract was part of a larger Contract, state percentage of the larger Contract which the contract represented.

2. Does the applicant have a valid ISO 9001, OHSAS 18001 and/or ISO 14001 certification? If so, attach (as **Attachment-3** to this Section Three) a copy of each certificate.

At present Centech International does not have the above certificates.

(SEE CONTINUATION #2 noted in SECTION THREE-CONTINUATIONS)

3. The applicant shall provide a detailed account of management techniques employed by it for the different categories of wastes in the Oil and Gas Industry, as of date?

Centech International employs the technique of mechanical separation remediation of oil from waste through a three-phase centrifuge system with a "fuzzy logic" feed-forward control system. The centrifuge system is used to separate meta-stable three-phase oil and water emulsions that are stabilized by solids. These emulsions are considered to be unstable and must be disposed of in an environmentally acceptable manner. **(SEE CONTINUATION #3 noted in SECTION THREE CONTINUATIONS)**

4. The applicant shall provide in details the proven volume of wastes collected, segregates, transported, recycled, treated and disposed by unit time for each waste management technique utilized by it?

Three-phase Centrifuge Mechanical Separation of oil from waste. **(SEE SECTION THREE, ATTACHMENT No.1)** for a volumes summary of wastes recycled, treated, and disposed of.

5. The Applicant shall provide any certification program for certifying laboratory facilities for the analysis of wastes, specifically hazardous wastes? If so, provide a list of certified Laboratories and the screening guideline utilized.

Centech International employs several factors in determining the capabilities of laboratory facilities to perform analyses of oil waste by-products. Site Data Collection & Sampling, Data Management, QA/QC Objectives, Regulatory Requirements, and the over all Waste Management Plan are all important factors of consideration in the assessment of qualified laboratories. **(SEE CONTINUATION #5 noted in SECTION THREE CONTINUATIONS)**

6. The Applicant shall provide a detailed QA/QC program utilized to meet the regulatory threshold limits for each pollutant against the regulatory requirement.

In conjunction with regulatory guidelines, Centech's QA/QC Plan provides comprehensive checks and balances that monitors all phases of the Waste Management Plan with intensive focus on qualified personnel, personnel training, Data Collection & Data Management, performance standards, health, safety and environmental objectives. **(SEE CONTINUATION #6 noted in SECTION THREE CONTINUATIONS)**

7. The Applicant shall provide a detailed account of all lessons learnt during its waste management projects to satisfy regulatory and other compliances.

Centech International has learned valuable lessons throughout its performance history that have enhanced our ability to satisfy regulatory and other compliances of which we note the following. **(SEE CONTINUATION #7 noted in SECTION THREE CONTINUATIONS)**

SECTION THREE- CONTINUATIONS

CONTINUATION #2: Does the applicant have a valid ISO 9001, OHSAS 18001 and/or ISO 14001 certification? If so, attach (as **Attachment-3** to this Section Three) a copy of each certificate.

As Centech International was acquired by its current parent company (OTES, WLL) in August 2007, requirements for the above cited ISO and OHSAS certifications are under assessment and we are confident that our goal of obtaining certifications for these controls will be successful. The following overview of our on-going certifications assessment is provided:

ISO 9001 Certification:
These controls will implement the requirements of the international standard ISO 9001:2000 and are designed to provide guidance to all Centech personnel, including subcontractors, in the application of the company's ISO 9001:2000 Quality Management System (QMS) and to demonstrate to customers that the company complies with the highest quality standards. Associated documents; e.g., procedures and work instructions, detail how the policies and requirements of individual elements described therein are implemented. The major functional areas include:

a) Supply and Services
b) Maintenance
c) Data/Information Management
d) Fire and Emergency Services
e) Business Management
f) Operations
g) Environmental Protection, Health & Safety
h) Quality Control and Training
i) Waste Management

OHSAS 18001 Certification:
These controls will address and implement relevant OHSAS 18001 requirements to ensure occupational health and safety management throughout Centech's functional areas.

a) Occupational Safety and Health Policy that clearly states overall health and safety objectives and a commitment to improving health and safety performance
b) Planning for Hazard Identification, Risk Assessment and Risk Control
c) Legal and Other Requirements that communicate relevant information on legal and other requirements to its employees and other relevant interested parties
d) OSHA Objectives
e) OH&S Management Program
f) Implementation and Operation (Structure and Responsibility)
g) Training, Awareness and Competence
h) Consultation and Communication
i) Documentation
j) Document and Data Control
k) Operational Controls
l) Emergency Preparedness and Response
m) Checking and Corrective Action (Performance Measurement and Monitoring)
n) Accidents, Incidents, Non-conformances and Corrective & Preventive Action
o) Records and Record Management
p) Audits
q) Management Reviews

CONTINUATION #3: The applicant shall provide a detailed account of management techniques employed by it for the different categories of wastes in the Oil and Gas Industry, as of date?

Centech, developed a novel, three-phase centrifuge process for the recovery of oil from tank bottoms and sludge. The process was the winner of a 1993 R&D100 award and is protected by 1992 and 2005 patents. Centech has been in business for over two decade using this technology to successfully treat nearly 1,000,000 barrels of tank bottoms and sludge including completion/work over, production, industrial, and refinery wastes.

Centech's three-phase centrifuge process is a one-of-a-kind portable system used in oil fields to recover oil and eliminate wastes from tank bottoms, waste oil pits, and refineries. Tank bottom wastes are not considered hazardous wastes, however refinery wastes residue recovery is often considered hazardous waste. The feed to the centrifuge system is quite different in each of these cases. In fact, the feed in the oil field can vary dramatically field to field, as it also does from refinery to refinery. These variable feeds requires an adaptable filter for the signals to the feed-forward controller to avoid centrifuge plugging and system shutdowns. Our patented "fuzzy logic" feed-forward control system is used for feed disturbance rejection. It works in conjunction with, and is capable of over-riding the actions of a feedback controller. The measured feed variables for the controller each exhibit reasonably large random fluctuations. It is therefore quite important to use a signal filter that truly recognizes the difference between random noise and a "caused event, in order to prevent over-riding a perfectly good correction from the feedback controller. The "fuzzy-SPC filter" and the "conflict resolution program" differentiates between noise in the measured feed variable and a true change in the feed.

The main components of the system are the centrifuge, the feed pump, feed heater, and product tanks. Sometimes the system includes a feed tank, but often the feed is taken directly from a waste pit or pond. The three controlled variables are the basic sediment and water (BS&W) in the product oil, the hydrocarbon content of the product water, and the hydrocarbon content of the product solid. The impurity limits for these three streams vary state to state (in the United States), from country to country, and sometimes even from site to site. For example, New Mexico requires BS&W the content of the oil to be 1% or less in order to be pipeline quality while Wyoming requires 0.3% or less. Centech's centrifuge technology consistently produces salable pipeline oil of 0.3% BS&W.

Documented results show that this three-phase centrifuge is capable of separating tank bottoms and sludge into three product streams: (1)pipeline quality oil, (2)water with 2-3 ppm total dissolved hydrocarbon, (3) and land-fillable solids. Our technology successfully separates oils with levels of processed emulsion ranging from:

▶ oil content levels with low of 10% to a high of 90%+
▶ water levels from 5% to 80%
▶ solids levels from 5% to 85%

Unlike similar techniques, the Centech's centrifuge **"one pass mechanical G-Force separation"** process eliminates most chemical treatment to break emulsion, high cost of chemicals and storage, and unnecessary time & commitment; and enhances the value of material released from emulsion, cost effectiveness, and timely separation into water, oil, & solids.

The Centech technology provides an excellent solution to a serious environmental problem. It is capable of turning a waste oil product into a much needed and saleable product pipeline grade oil.

CONTINUTATION #5: The Applicant shall provide any certification program for certifying laboratory facilities for the analysis of wastes, specifically hazardous wastes? If so, provide a list of certified Laboratories and the screening guideline utilized.

Centech centrifuge technology focuses on three areas of controlled variables: (1) basic sediment and water (BS&W) in the product oil, (2) the hydrocarbon content of the product water, (3) and the hydrocarbon content of the product solid. The impurity limits for these three streams vary state to state (in the United States), from country to country, and even from site to site.

Ensuring successful accomplishment of Performance and Restoration Standards begins with qualified Centech Staff and Consultants knowledgeable of well-established analytical methods that are used as the standard protocols approved by federal agencies, industry standards such as the American Petroleum Institute (API), and organizations such as EPA, and the National Institute for Occupational Safety and Health (NIOSH), ASTM, or methods prescribed by state governments for water and soil analysis. Laboratory analysis of oil production waste by-products is crucial in achieving safety/ health/and environmental objectives. Centech's screening of viable Laboratory facilities includes the following minimum criteria:

a. Since regulatory requirements are the driving force of performance and restoration standards, laboratories are screened for well-established analytical methods approved by federal agencies such as EPA, National Institute for Occupational Safety and Health (NIOSH), Occupation Safety & Health Administration (OSHA), ASTM, among others which address key aspects of the oil and gas industry, including exploration and production, refining, fire protection and safety, petroleum measurement, health and environmental issues, valves, storage tanks, etc.

b. Laboratories must possess approved methodologies for identification and quantification of exact and/or total composition applicable to basic sediment and water (BS&W) in the product oil, the hydrocarbon content of the product water, and the hydrocarbon content of the product solids.

c. Laboratory facilities must be capable of the following minimum waste analyses capabilities among others:

- ▶ pH
- ▶ flashpoint
- ▶ water, oil, soil
- ▶ total dissolved solids or specific conductance
- ▶ metals concentrations (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, etc)
- ▶ TPH TOX using (TCLP)Toxicity Characteristic Leaching Procedure for volatile organics i.e. (vinyl chloride; 1,1-Dichloroethene; Chloroform; 1,2-Dichloroethene; Benzene; 2-Butanone MEK); Carbon tetrachloride, other volatile organics)
- ▶ Radium 226
- ▶ non halogenated constituents
- ▶ sulfur %
- ▶ polymers
- ▶ fecal coliform as applicable
- ▶ other constituents or hazardous waste criteria determined to be appropriate by environmental or water quality agencies
- ▶ on-site analysis as applicable to assessment of air quality constituents

d. Lab facilities must be knowledgeable in providing guidance reference sample volume, number/type of sampling containers, preservatives and shipping instructions in accordance with established regulatory requirements.

e. Facility should be ISO Certified.

f. A standard checklist of Analytical Methodologies approved by regulatory agencies and international protocols:

- ▶ AOAC Test Methods ["Association of Analytical Communities," AOAC INTERNATIONAL]
- ▶ ASTM Test Methods [Formerly known as the American Society for Testing and Materials, ASTM International]
- ▶ ISO [International Organization for Standardization]
- ▶ EPA Test List [U. S. Environmental Protection Agency]
- ▶ DIN Standardization Methods [Deutsches Institut für Normung]
- ▶ Standard Methods for the Examination of Water and Wastewater
- ▶ CFR Test Methods, U.S. [The Code of Federal Regulations]
- ▶ I P Test Method [The Institute of Petroleum]
- ▶ National Fire Protection Association [NFPA]
- ▶ Federal Test Method Standard
- ▶ World Health Organization [World Health Organization]
- ▶ UOP™ Test Methods [Universal Oil Products]
- ▶ Others as applicable

Certified Laboratories

- ▶ Intertek Lab, Kuwait
- ▶ PAAC-Central Environmental Lab, Kuwait

CONTINUTATION #6: The Applicant shall provide a detailed QA/QC program utilized to meet the regulatory threshold limits for each pollutant against the regulatory requirement.

As Centech's primary waste management technique for oil waste remediation is a patented three-phase centrifuge technology with a 100% success rate remediation of oil production waste pits, seeps/spills, tanks/sumps (ASTs and USTs), including facility piping and miscellaneous fluids in containers and barrels on project sites; three by-products are reclaimed from the centrifuge process: **1)** pipeline quality oil with 0.3% BS&W, **2)** separated water with 2-3 ppm total dissolved hydrocarbon, **3)** and separated solids which can be safely used as a landfill component after centrifuge treatment with less than 100 mg/kg TPHs, benzene and metals concentrations less than the toxicity characteristic, and any other identified hazardous characteristic must be below the regulatory standard. All reclaimed by-products standards are confirmed by laboratory analysis before final disposition.

Use of patented centrifuge artificial intelligence 'fuzzy logic' that captures and uses the experience and expertise of a highly skilled centrifuge operator monitors several feed variables simultaneously which effect the quality of the reclaimed by-products. One pass G-Force separation eliminates most chemical treatments to break emulsions which enhances the value of material released from emulsion, promotes cost effectives and timely separation into oil, water, and solids. Other proprietary technology includes electrical heating of sludge eliminating the need for open flame to power steam generators and a proprietary system for recovery gas vapors generated by centrifuge during the remediation process. Centech's centrifuge technology is of itself an effective front-end quality control tool.

QA/QC for meeting the regulatory threshold limits for each pollutant against the regulatory requirement is an important part of the overall Centech Waste Management Plan. The following procedures address guidelines employed to meet threshold limits for pollutants.

▶ Fluids from referenced units (pits, tanks/sumps, facility piping, barrels, etc) will be transferred by conventional vacuum methodology as appropriate to the centrifuge unit for processing. All transfer operations will be performed in accordance with established spill control provisions specified in the Contingency and Spill Response Plan and/or other applicable regulatory guidelines. If fluid transfer operations proceed at a larger rate than the treatment capacity of centrifuge units, temporary storage units (steel "frac" tanks with heating coils) will be utilized to ensure fluid transfer to the centrifuge.

▶ Before centrifuge treatment can be performed, site sampling and data collection will be conducted for laboratory analysis of constituent toxicity. After laboratory analysis, feedstock will be fed into the Centech centrifuge at a controlled rate and treated as appropriate according to relevant feed stock variables. Feed stock control rate and treatment process is monitored via patented intelligent 'fuzzy logic' design.

▶ <u>Reclaimed Petroleum</u> (0.3% BS&W): Reclaimed petroleum, meeting appropriate specifications, will be available to KOC pipeline/refinery. The oil will be tested in accordance with established KOC test standards, Quality Assurance, Data Collection & Data Management Plan before transfer to KOC.

▶ <u>Separated Water</u> (with 2-3 ppm total dissolved hydrocarbon): Water generated in the centrifuge treatment process will be stored in tanks onsite or as designated. A certain volume of the water will be re-used as makeup water in the centrifuge process. The remaining volume of water will be analyzed in accordance with the Quality Assurance, Data Collection & Data Management Plan and pursuant to applicable permits before any disposal occurs. The means of disposal is dependent on the exact composition of the water as confirmed by laboratory analysis, the particular operational conditions, and the weather at the time that disposal is necessary. Disposal options for separated water include application to desorbed soil for re-hydration, application to ground/roads for dust control, point-source discharge, or injection in a permitted well.

▶ Separated Solids (<100 mg/kg TPHs, benzene and metals concentrations less than the toxicity characteristic, and any other identified hazardous characteristic must be below the regulatory standard): Separated solids will be analyzed in accordance with the Quality Assurance, Data Collection & Data Management Plan to ensure material is in compliance with established regulatory pollutant limits.

▶ Soil Excavation: When soil excavation is performed, the following standards will be attained for material left in place. Total hydrocarbons less than 100 mg/kg, benzene and metals concentrations less than the toxicity characteristic, and any other identified hazardous characteristic must be below the regulatory standard. All excavations will be sampled for laboratory analysis for parameters included in the performance standards in accordance with the Quality Assurance, Data Collection & Data Management Plan.

▶ Solid Waste: Conventional wastes such as office waste and by products which do not contain free hydrocarbons will be disposed of as designated by established guidelines.

QC/QA Control Plan

GENERAL

a. Waste Analysis

(1) Waste analysis may be performed by the generator of the waste, the treatment facility, independent laboratory, or any combination of these. Depending on the waste type concern, the objectives for testing wastes may include:

▶ Verifying that the waste is an Energy & Production (E&P) waste and is approved for disposal at the facility;
▶ Verifying that a non-exempt waste is non-hazardous (testing for hazardous characteristics);
▶ Identifying potential community issues, such as odor or visible emissions; and
▶ Identifying potential safety or environmental hazards to site employees or surrounding area.

(2) As specific testing criteria are established by federal, local, and industry regulations, or by permit conditions; consideration to limit the potential of future liability through prudent testing is often employed. For many established customers, knowledge of the process or source of the wastes, or an initial waste profile, may be all that is necessary. Centech employs the following spot-check standard to it customers or for new waste streams:

▶ Visual observations;
▶ pH checks;
▶ Conductivity or chloride testing;
▶ Testing of the vapors for flammability or hydrocarbon content; and
▶ Testing of vapors or liquid for reactive sulfides.

There are a variety of published data sources that may provide an indication of the constituents of various E&P waste streams. While these cannot substitute for knowledge of the specific waste being treated, they may assist facilities in determining the types of wastes to be accepted/or treated and which waste streams, if any, may be appropriate for testing.

b. Sampling and analysis.

(1) Existing workplans. Sampling and analysis for sites subject to an approved workplan shall be conducted in accordance with the workplan and the sampling and analysis requirements described in this rule.

(2) Methods for sampling and analysis. Sampling and analysis for site investigation or confirmation of successful remediation shall be conducted to determine the nature and extent of impact and confirm compliance with appropriate allowable concentrations.

c. Field analysis. Field measurements and field tests shall be conducted using appropriate equipment, calibrated and operated according to manufacturer specifications, by personnel trained and familiar with the equipment.

d. Sample collection. Samples shall be collected, preserved, documented, and shipped using standard environmental sampling procedures in a manner to ensure accurate representation of site conditions.

e. Laboratory analytical methods. Laboratories shall analyze samples using standard methods (such as EPA SW-846 or API RP-45) appropriate for detecting the target analyte. The method selected shall have detection limits less than or equal to the allowable concentrations.

f. Background sampling. Samples of comparable, nearby, non-impacted, native soil, ground water or other medium may be required by the Director for establishing background conditions.

g. Soil sampling and analysis.

(1) Applicability. If soil contamination is suspected or known to exist as a result of spills/releases or E&P waste management, representative samples of soil shall be collected and analyzed in accordance with this rule.

(2) Sample collection. Samples shall be collected from areas most likely to have been impacted, and the horizontal and vertical extent of contamination shall be determined. The number and location of samples shall be appropriate to the impact.

(3) Sample analysis. Soil samples shall be analyzed for contaminants listed as appropriate to assess the impact or confirm remediation.

(4) Reporting. Soil Analysis Report Form, shall be used for documentation results of soil analyses.

(5) Soil impacted by produced water. For impacts to soil due to produced water, samples from comparable, nearby non-impacted, native soil shall be collected and analyzed for purposes of establishing background soil conditions including pH and electrical conductivity (EC). Where EC of the impacted soil exceeds the allowable level the sodium adsorption ratio (SAR) shall also be determined.

(6) Soil impacted by hydrocarbons. For impacts to soil due to hydrocarbons, samples shall be analyzed for TPH.

h. Ground water sampling and analysis.

(1) Applicability. Centech personnel shall collect representative samples of ground water & expedite analysis in accordance with these rules under the following circumstances:

i. Where ground water contamination is suspected or known to exceed the allowable concentrations

ii. Where impacted soils are in contact with ground water; or

iii. Where impacts to soils extend down to the high water table.

(2) Sample collection. Samples shall be collected from areas most likely to have been impacted, down gradient or in the middle of excavated areas. The number and location of samples shall be appropriate to determine the horizontal and vertical extent of the impact. If the allowable concentrations are exceeded, the direction of flow and a ground water gradient shall be established, unless the extent of the contamination and migration can otherwise be adequately determined.

(3) Sample analysis. Ground water samples shall be analyzed for benzene, toluene, ethylbenzene, xylene, and API RP-45 constituents, or other parameters appropriate for evaluating the impact.

(4) Reporting. Water Analysis Report Form shall be used for documentation results of water analyses.

(5) Impacted ground water. Where ground water contaminants exceed the allowable concentrations, Centech shall notify the Designated Representative and submit to the same prior approval a Site Investigation and Remediation Workplan Form, for the investigation, remediation, or monitoring of ground water to meet the required allowable concentrations.

i. Cross-media impacts

The overall goal of waste treatment is to reduce the volume or the toxicity of waste that has been accumulated or delivered to a facility so that the waste can be disposed without harm to human health or the environment. In treating a waste stream, Centech will assure that the potentially harmful components are not inadvertently being transferred from one media to another. Our selection of the three-phase centrifuge treatment method for waste type and volume in conjunction with a pre-approved plan ultimate disposal method ensures effective quality control for these factors allowing for safer and more effective waste management, resulting in decreased exposure of waste components to human health and the environment.

j. Secondary disposal

Some waste treatment processes result in residual material. This residual, post-treatment waste should be disposed of in ways that minimize any adverse impacts to human health and the environment. Re-use or recycling of residual material is desirable where feasible, as regulatory guidelines specify constituent levels that must be met for residual material to be re-used. Potential re-uses of residual material include landfill cover and fill dirt for road building or other construction activity. Centech will keep records of the volume of residual material moved off-site, any analyses of the residual material, its intended use, and ultimate location.

1.0 Health and Safety Risk Analysis (Health, Safety, & Environmental)

All persons working on the site will observe all applicable rules and regulations established by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and other applicable regulatory guidelines.

Work at the site is associated with a variety of hazards, both physical and chemical. The purpose of this plan is to reduce the risks of working on the site. The preferred method is to eliminate the hazard, whenever practicable; the second choice is to use engineering controls; the Last choice is to use personal protective equipment. The general hazards to be encountered on the site, and the procedures to reduce these hazards, are presented below. The first task at the site shall be to gather miscellaneous debris scattered throughout the Work and Treatment Zones and store it in the Staging Area. Existing scaffolds and elevated walkways will be evaluated. Those items unnecessary to site operation and posing a potential hazard will be dismantled. Those items necessary to operation will be examined and repaired, as needed. Thereafter, the Project Site Manager will make weekly examinations of the structures and ensure proper maintenance. Potential site hazards have been grouped into four categories: heavy equipment, fire, other physical hazards, and chemical hazards

1.2 Heavy Equipment

Some of the most hazardous situations that may occur are associated with heavy equipment operation. The following requirements are intended to alleviate these hazards.

- Operators must be qualified on equipment; documentation will be required.
- Heavy equipment must be kept at least 15 feet away from poles that support overhead power lines.
- Back-up alarms are required.

▶ Personnel must make eye contact with the operator before approaching the equipment.
▶ Operators must wear seat belts when they are available.

1.3 Fire/Explosion Hazards

Onsite personnel may be exposed to fire/explosion hazards at any time. These hazards include:

▶ Excavating into underground tanks containing liquid petroleum hydrocarbons or fumes;
▶ Excavating into underground pipelines carrying liquid petroleum hydrocarbons or fumes;
▶ Dismantling and removing above-ground storage tanks containing liquid petroleum hydrocarbons or fumes;
▶ Generation of hydrocarbon vapor clouds during tank-emptying activities;
▶ Sparking of combustible petroleum hydrocarbons in the air, in soil gas, on soils; and
▶ Equipment fires.

1.3.1 Ignition Sources

Because of the flammable nature of hydrocarbons, ignition sources other than the treatment units will be kept out of the Work Zone and Treatment Zone:

▶ No matches or cigarette lighters are allowed in the Work or Treatment Zones. A hot-work permit will be required for open-flame work.
▶ Internal combustion engines must not be operated in the Work Zone while hydrocarbon-contaminated solids or liquids might be brought to the surface; alternatively, they must be equipped with spark arresters.
▶ Intrinsically safe hand, electrical, and mechanical (non-sparking wrenches, etc.) shall be used when working on drums and while working in the Work Zone.
▶ Explosion-proof instruments and system-wide electrical grounding will be used to prevent fires.

1.3.2 Fire Precautions

Subcontractors on the site shall comply with all requirements of this document and of the Uniform Fire Codes, and KOC-Fire & Safety Regulations in providing temporary storage of materials used in their treatment processes. All vehicles in the Work and Treatment Zones must be equipped with an appropriate fire extinguisher.

The following additional precautions will be observed to minimize the potential for fire or explosion:

▶ Excavation will proceed slowly for the first five feet to minimize damage to underground lines.
▶ Combustible gas measurements will be taken regularly during the excavation of a tank and during tank entry.
▶ Tanks shall be vented or purged before fluids are removed; if Ere, smoke, or heat emanates from any tank or excavation, personnel will evacuate the vicinity immediately; work will not resume until the signs of fire or explosion have disappeared.
▶ If total organic vapors exceed 10% of the lower explosive limit (LEL) in the Work Zone, personnel will stop work and move upwind. Measures (such as a nitrogen gas purge) will be taken to subdue combustible vapor emissions.

1.3.3 Fire-Fighting Equipment

Fire extinguishers (type BC or equivalent) and fire blankets will be located on posts throughout the Work Zone. However, *fire extinguishers are to be used only in the incipient stages of a fire*. Fire extinguishers shall be inspected periodically and maintained in operating condition.

1.3.4 No Smoking Area
No smoking is permitted within the site perimeter fence.

1.4. Other Physical Hazards
Feasible engineering controls shall be utilized to protect employees against excessive noise, in accordance with 29 CFR 1910.95 (*see Table 1-1*). The noise will be monitored throughout the site. Noise levels that exceed an 8-hour time-weighted average of 85 decibels require a haring conservation program.

TABLE 1-1 PERMISSIBLE NOISE EXPOSURES	
Duration per Day-Hours	**Sound Level in Decibels**
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

1.5 Buildup of Explosive Gases
The presence of combustible/explosive gases will be monitored whenever the potential exists for their accumulation. Further action will be taken if the level exceeds 10% of the Lower Exposure Limit (LEL). The OSHA limits of employee exposure to chemicals; found primarily in 29 CFR 1910.1000, Table Z-1.

1.6. Splashes
Shower and eye wash facilities will be available in the office trailer in the event of an emergency. If the MSDS for any chemical brought onsite calls for an eyewash, an eyewash station shall be established in the immediate vicinity of that chemical's use.

1.7 Pits
The pits will be covered with netting most of the time. Work at the pits will be performed remotely whenever practical. Caution must be exercised near the pit edges. A lifeline will be available at the pit when work is in progress there.

1.8 Propane Tanks
Propane tanks shall comply with OSHA 29 CFR 1910.106 and with appropriate fire codes.

1.9 Fugitive Dust
A potential hazard on the site will be nuisance dust, especially in the warm months during windy conditions. Monitoring of airborne particulates will be performed on the site and evaluated for associated health risks. If the airborne particulate level approaches permissible exposure limits, dust-control measures will be implemented. The use of respirators will be required if the situation presents a health hazard. See Section 2.3 Heavy Metals.

2.0 Chemical Hazards
Potentially hazardous chemicals that have been detected on the site include those shown in *Table 1-2*. The maximum concentration found on the site and the location of that concentration are given. Also shown are the *recommended exposure limits* (REL.) determined by the National Institute for Occupational Safety and Health (NIOSH) and the OSHA time- weighted average *permissible exposure limits* (PEL).

2.1 Chemicals
Any chemicals brought to the site must be accompanied by *material safety data sheets (MSDSs)*, to be located in the office trailer and made available to all site personnel. Protective equipment, including eyewash stations, shall be provided as specified in the MSDSs. Each subcontractor is responsible for providing hazard communication training to its employees regarding these chemicals.

2.2 Petroleum Products on Site
The chemical products on the site consist primarily of petroleum products. Material data safety sheets (MSDSs) will be provided for all identified products located on the site. Evaluations indicate that the most likely chemical hazard is benzene. Because analytical data may reveal the presence of sulfur and because hydrogen sulfide is a common hazard associated with crude oil, hydrogen sulfide will also be monitored. Direct reading tubes will be used to monitor for these substances.

2.3 Heavy Metals On Site
An evaluation will be performed to identify if any of the metals cited in *Table 2-1* might pose a health hazard to personnel on site. Arsenic, for example, is found in the soil and could be inhaled on particulates during dry, windy days. However, before the arsenic in the dust would exceed its permissible exposure limit, the nuisance dust itself would have far exceeded both the permissible exposure limit and tolerable levels. In other words, dust and not arsenic-laden dust—is the primary concern. If sources of contamination at higher concentrations are identified on the site, this conclusion could change. Centech is cognizant of potential exposure pathways and will be alert to new information.

TABLE 2-1 CONCENTRATION LIMITS FOR SELECTED CHEMICALS WHICH MAY BE FOUND ON SITE

Chemical	Media	NIOSH REL	OSHA PEL
Benzene	fluid	0.1 ppm	1 ppm
Toluene	fluid	100 ppm	100 ppm
Ethylbenzene	fluid	100 ppm	100 ppm
Xylene	fluid	100 ppm	100 ppm
Arsenic	soil	0.002 mg/m^3	0.01 mg/m^3
Barium	fluid	0.5 mg/m^3	0.5 mg/m^3
Chromium	fluid	0.5 mg/m^3	0.5 mg/m^3
Lead	fluid	0.1 mg/m^3	0.5 mg/m^3
Cadmium	soil	minimize	0.2 mg/m^3
Nickel	fluid	0.15 mg/m^3	0.1/m^3
Vanadium	fluid	0.05 mg/m^3	0.05 mg/m^3
Silver	fluid	0.1 mg/m^3	0.1 mg/m^3
Sulfur	fluid	10 ppm H_2S	10 ppm H_2S

REL = recommended inhalation exposure limit
REL = permissible inhalation exposure limit

3.0 Personal Protective Equipment
Level C and D protection shall be available for use on the site.

Level D protection is the minimum protection required in the Work and Treatment Zones. Level D will be satisfactory when:

- the atmosphere contains no know hazard
- the work functions contain no risk of splashing, immersion, inhalation, or contact with hazardous chemicals, and
- atmospheric concentrations are below one-half the threshold limit value for contaminants

Level D protection will consist of the following items; all of which meet applicable standards set by the American National Standards Institute (ANSI).

- sturdy work shoes or ANSI approved safety-toed shoes/boots
- hard hat
- safety glasses

Level C adds the use of respiratory protection, all certified by the National Institute for Occupational Safety and Health (NIOSH):

- full-face or half-face, air purifying respirator
- combination organic vapor/HEPA filter cartridge

Respirator protection will be required when the photoionization detector (PID) reading in ambient air exceeds 100 ppm TOV or when the dust monitor or indicator tubes reveal exposure levels exceeding permissible exposure limits. An indicator tube will be used to measure benzene concentration whenever the PID level exceeds 5 ppm above background.

4.0 Air Monitoring Program

Air monitoring will be performed in accordance with OSHA 29 CFR 1910.120(h) to evaluate air quality in order to:

- determine the appropriate protection required for site workers,
- identify areas where protection is needed,
- assess the potential health effects of exposure, and
- determine the need for specific medical monitoring
- air monitoring will also be used to establish background or baseline levels

4.1 Air-Monitoring Equipment

The equipment shown in *Table 4-1* will used. The table summarizes the intended use of each instrument, action levels, frequency of calibration, and equipment limitations.

4.2 Calibration Specifications

The equipment will be calibrated using the specifications shown in *Table 4-2.*

4.3 Personal Monitoring

To confirm that individual worker exposure is below permissible limits in Level D protection, Centech will administer a personal monitoring program. This monitoring will occur at least annually. During work operations, the person deemed to have the highest exposure to organic vapors will be equipped with personal monitoring devices to measure such chemicals as benzene, toluene, xylene, and ethylbenzene. If the monitoring reveals no dangerous exposure, then all persons performing similar work will be assumed to be safe in Level D protection.

Personal dust monitoring will be done for a person working in the most dusty area. Exposure to arsenic, lead, cadmium, and chromium will be measured to confirm that Level D protective measures are adequate.

TABLE 4-1 AIR MONITORING EQUIPMENT SPECIFICATION

Instrument	Use	Action Levels		Frequency	Calibration	Limitations
Barcharach Sniffer 302 Combustible gas indicator 0_2 meter	Detection of explosive/ flammable atmosphere	<10% LEL 10-20% LEL >20% LEL	Continue work Move upwind; vent or purge Explosion hazard; stop work; leave area	As needed	Daily & after any reading >100 LEL	Invalid <-4° F; Tetraethyl lead, sulfur, & silicone poison sensor
	Measurement of % 0_2 in air	>25.0% 0_2 20.9% 0_2 <19.5% 0_2	Explosion hazard; evacuate or purge Normal 0_2 0_2 deficient; vent or use SCBA	As needed	Daily	
Determinator Photoionization Detector (PID)	Measurement of total organic and some inorganic gases & vapors	≥5 ppm <100 ppm ≥100 ppm	Check for benzene Level D protection Level C protection	As needed	Daily	Cannot sense methane; IP of chemical must be < lamp energy; dirt & humidity foul the lamp
Direct Reading Tubes	Measurement of benzene	<1 ppm 1-9 ppm ≥10 ppm	Level D protection Level C protection Stop work; evacuate situation	When PID >5 ppm or at start of new activities that could emit benzene	N/A	
	Hydrogen sulfide	≥10 ppm	Stop work; evacuate situation	As needed		
Dust Monitor: Mini-Ram	Measurement of airborne particulates	≥5 mg/m^3 ≥15 mg/m^3	Apply dust controls put on respirators or stop work	As needed	Zero daily	
Noise Level Monitor	Measurement of noise levels	≥90 decibels	Use hearing protection	As needed	To be determined	

TABLE 4-2 CALIBRATION SPECIFICATION

Instrument	Gas	Reading
Determinator PID, 10.2 eV Lamp	100 ppm isobutylene in air	100 ± ppm
Bacharach Sniffer 301 CGI	2.5% methane in air	50% LEL ± 5% LEL
+ 0_2 meter	Normal ambient air	20.9%
Century OVA-88	Double internal calibration points	100 ppm 100,000 ppm

5.0 Decontamination Procedures

Decontamination is necessary both to protect workers from hazardous materials and to minimize the transfer of these materials to clean areas or off the site. Decontamination is conducted both as a quality assurance measure and a safety precaution. Prevention is the first step:

- avoid areas of obvious contamination
- avoid getting contamination on skin or clothing
- wear disposable clothing when appropriate

All equipment entering the Work Zone shall be decontaminated before leaving the site. All persons entering the Work Zone or the Treatment Zone shall decontaminate before entering the "Clean Area". Materials generated during decontamination will be collected and disposed of in accordance with applicable federal and state regulations.

5.1 Decontamination of Personnel

A decontamination room will be available in a designated area. All persons entering the designated area from the site shall enter through the decontamination end and apply appropriate decontamination measures before entering the clean area. A change room, sink, and shower are available for use.

Disposable clothing shall be removed in the following order: boots, gloves, and then cover suit. Personnel shall place disposable clothing items in the designated waste container. Contaminated boots shall be left outside the trailer. Work boots shall be dry-brushed to remove soil. Hands shall be thoroughly washed with soap and water, rinsed, and dried.

5.2 Emergency Decontamination

Injured personnel may require decontamination before being transported to the hospital. However, if prompt, life-saving first aid and medical treatment are required, decontamination procedures should be omitted. Response personnel should accompany contaminated victims to the medical facility to advise on matters involving decontamination.

If the situation permits, the outside garments can be removed. Respirators and backpack assemblies must always be removed. Chemical-resistant clothing can be cut away. If outer contaminated garments cannot be safely removed, the individual should be wrapped in plastic, rubber, or blankets to help prevent contamination of the ambulance and medical personnel. Do not wash or rinse victim at the site, unless it is known that the individual has been contaminated with an extremely toxic or corrosive substance that could cause severe injury or death. For minor medical problems or injuries, use the normal decontamination procedures.

5.3 Decontamination of Sampling Equipment

All sampling and monitoring equipment used on the site will be decontaminated under the procedures specified in the WWC Standard Operating Procedure #89-05, contained in Appendix B.

- Standard Procedures

1) Remove any solid particles from the equipment or material by brushing and then rinsing with tap water. This initial step removes gross contamination.
2) Wash equipment with soap or detergent solution.
3) Rinse with tap water.
4) Rinse with distilled or deionized water.
5) Repeat entire procedure or any parts of the procedure if necessary.
6) Allow equipment to air dry before re-using. If equipment is not used immediately, wrap in aluminum foil to prevent the equipment from becoming re-contaminated.
7) Contaminated materials and any wash water should be containerized and properly disposed of or treated.

▶ Specific Decontamination Procedures (Submersible Pump)
The following procedure will be used to decontaminate submersible sampling pumps prior to each use.

A) Materials

-- plastic upright cylinder (drum or capped length of pipe)
-- 5-10 gallon plastic storage containers
-- acetone and dispenser bottle
-- deionized water and dispenser bottle
-- chemical-free paper towels
-- clean plastic sheeting

B) Procedure

1) Clean the upright plastic cylinder with appropriate cleaning solution and/or solvent, followed with a deionized water rinse. Wipe off any free liquids after each rinse.
2) Remove the pump from the previous well if necessary. Wipe the power cord and discharge line dry with chemical- free disposable paper towels.
3) Reverse pump to backwash residual liquid in the pump tubing. The pump should be shut off as soon as intermittent flow is observed from the reverse discharge.
4) Place the pump on a clean surface or hold off of the ground.
5) Wash and rinse the stainless steel submersible down-hole pump section with liberal applications of the appropriate solutions and/or solvents and wipe dry.
6) Place the submersible pump section upright in the cylinder and fill the cylinder with tap water, adding appropriate amounts of cleaning solution.
7) Activate the pump in the forward mode, withdrawing water from the cylinder.
8) Continue pumping until the water in the cylinder is pumped down and air is drawn through the pump. Shut off the pump immediately.
9) Remove the pump from the cylinder and place the pump in the reverse mode, allowing all removable water to be discharged as cited in item 4 above.
10) Using the water remaining in the cylinder, rinse the sealed portion of the power cord and discharge tube by pouring the water carefully over the coiled lines.
11) Place the pump in the well casing and wipe both the power and discharge lines dry with clean paper towel.

To ensure the efficiency of decontamination procedures, a specified number of equipment field blank samples shall be collected using cleaned submersible pump. The blank will be analyzed for the same parameters as the ground-water samples.

CONTINUATION #7: The Applicant shall provide a detailed account of all lessons learnt during its waste management projects to satisfy regulatory and other compliances.

Lessons Learned

Centrifuge Expert Fuzzy Logic Intelligence:
Because the s&w content of reclaimed oil must be below a particular limit, feed rate and feed temperature must be adjusted accordingly. Designated an automatically controlled three-phase centrifuge, Centech combines an expert fuzzy controller with a centrifuge. Running on a portable to ensure computer, the fuzzy controller duplicates human expertise in operating the machine. The controller is based on artificial intelligence (for the analysis of expert judgment) and adjusts operating conditions to give consistency to the quality of recovered oil, reduces maintenance & process costs, allows continuous measurement and simultaneous changes of important parameters such as (s&w, feed temperature, and feed rate); and eliminates the need for numerous time-intensive sample collections & analysis per day. The automatic controller gives the centrifuge a competitive edge in the steadily growing environmental clean-up market minimizing the need to change the properties of waste prior to treatment and serving as an effective tool in training operators in centrifuge waste remediation.

Centrifuge Vapor Emissions Control:
It is known that during centrifuge processing of fluids hazardous gas vapors may escape from the centrifuge unit into the air. These vapors if not secured pose a negative impact to air quality and personnel working in the treatment area. Additionally, air quality monitoring is an important regulatory requirement and failure to comply with established air quality standards can result in work stoppage by governing environmental agencies. Centech centrifuge inventor assessed this problem and designed a proprietary Centrifuge Gas-Vapor Recovery Unit for recovering gas vapors emitted during the centrifuge process. The vapor recovery unit collects and condenses the gaseous vapors into a collection vessel instead of releasing the pollutant into the air which adds a valuable quality control measure for pollutant vapors during the centrifuge process and ensures compliant to regulatory pollutant standards.

Land treatment units. The rate of emissions from a land treatment unit is directly related to the concentration of hydrocarbons present in the waste, the volatility of the hydrocarbons, the rate of application of the waste, the rate of biodegradation of the waste, and the soil's moisture content. One obvious option for reducing emissions from land treatment units is to decrease the rate at which wastes are applied to the unit and ensure that waste is not applied when wind conditions are likely to increase emissions.

8. The applicant shall provide administrative programmes to track details concerning accounting for the quantities of waste collected, segregates, transported, recycled, treated, and disposed.

Waste Accountability. Centech's waste tracking procedures serve as a regulate for waste accountability, employee safety, and transportation of E&P waste.
(SEE CONTINUATION #8 noted in SECTION THREE CONTINUATIONS)

9. The Applicant shall provide a detailed program based on previous experience that would address accounting details for compensations, requirements for third party audits and compliance reports to regulatory bodies.

Thorough accountability guidelines for compensations, audit requirements and compliance reports are addressed as follows:
(SEE CONTINUATION #9 noted in SECTION THREE CONTINUATIONS)

10. The Applicant shall provide the basis for selecting the different waste management techniques.

Centech's primary waste management technique is the treatment of the sludge gathered at production pits platform as per the needs of the clients through a proven three-phase centrifuge technology with 100% success rate as noted in Question #3.

11. The Applicant shall provide waste treatment practices that address Environment and Ecological conditions.

Centech International LLC will provide total environmental and recovery solutions for oil sludge treatments works to support local oil companies in Kuwait.

12. Fill in (as **Attachment No.2** to Section Three) Best Environmental Practices Waste Management Checklist in line with the guidelines provided in Attachment No.2.

Signature: Ernest W. Alexander

Name: Ernest W. Alexander

Name and Title of Authorized Signatory: Ernest W. Alexander- Managing Director

Applicant's Company Name: Centech International LLC

Applicant's Company Stamp: Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

CONTINUATION #8: The applicant shall provide administrative programmes to track details concerning accounting for the quantities of waste collected, segregates, transported, recycled, treated, and disposed.

Waste Tracking Accountability. This practice benefits the facility, providing a method to identify the waste and its sources, along with a certification by the generator, or hauler, or remediation that the waste is as described. Centech's waste tracking system considers the following:

▶Utilizing a multi-part form with information on the generator, hauler, and source facility; a description of the waste; the time and date it was collected, hauled, and deposited at the disposal facility; and the volume of the waste;
▶Retaining the form for a minimum of five years;
▶Certifying that wastes are exempt and have been properly handled/treated and
▶ Documenting laboratory analysis or discrepancies

Waste Acceptance Plan. Waste acceptance plans can help to ensure that facilities or project sites do not accept unauthorized waste types. The purpose of a waste acceptance policy is to define the requirements for characterizing, certifying, and documenting wastes handled by a facility or project site. Proper waste identification and treatment are necessary components for the safe and effective management of wastes. As regulatory agencies may specify testing requirements that assure facilities receive certain constituent data from waste generators, in some cases, additional information is required to appropriately manage certain wastes. In these cases, the treatment facility may need to conduct its own sampling and analysis before beginning treatment of the waste. As an alternative, a facility may elect to require additional information from waste generators prior to waste acceptance; this requirement would probably be limited to a few wastes or waste streams for which special handling may be appropriate. To assist on-site personnel in the acceptance process, Centech's policy includes, at a minimum, the following elements:

▶Types of wastes accepted;
▶Generators pre-authorized to dispose of wastes at the facility;
▶Waste haulers pre-certified to transport wastes to the facility; and
▶Procedures to follow when unauthorized wastes or wastes from an unauthorized generator or hauler arrive at the facility or project site.

Waste Accountability Documentation. Centech International shall utilize appropriate *documentation forms* and shall maintain such forms for not less than five years. Copies of each invoice, bill or ticket and such other records as necessary to document the following information from a waste transporter, waste received, segregated, recycled, treated or disposed shall be utilized at each site location:

(1) Waste Transported/Collected:
- ▶ the date of the transport
- ▶ the identity of the waste generator
- ▶ the identity of the waste transporter
- ▶ the location of the waste pickup site
- ▶ the type and volume of waste and
- ▶ the name and location of the treatment or disposal site.

(2) Quantity of wastes segregated, recycled, treated or disposed:
- ▶ the date of segregation, recycle, treatment, or disposition
- ▶ the type and volume segregated, recycled, treated, or disposed
- ▶ the method of segregation, recycle, treatment, or disposal
- ▶ any laboratory analysis performed and results/or discrepancies
- ▶ the location of segregation, recycle, treatment, or disposal
- ▶ the name and location of the treatment or disposal site

Such records shall be made available for inspection by regulatory agencies, auditors, and other authorized entities as applicable. Inspections shall be performed during normal business hours and copies of waste management accountability shall be provided upon request as applicable in accordance with regulatory requirements.

CONTINUATION #9: The Applicant shall provide a detailed program based on previous experience that would address accounting details for compensations, requirements for third party audits and compliance reports to regulatory bodies.

The Project Manager and supervisory controls shall ensure thorough documentation of the work at the site location ((see also item #8 Continuation). Documentation shall include:

▶ Data validation in accordance with the Quality Assurance, Data Collection, and Data Management Plan

▶ Daily reports describing the quantity and nature of work completed during the day, hours worked, remediation quantities, onsite personnel, weather conditions, sampling performed, visitors to the site, incident reports, and any unusual conditions

▶ Weekly reports prepared by Project Coordinators summarizing the daily activities and submitted to technical representatives

▶ Monthly progress reports submitted by tenth day of each month to the designated regulatory agencies as applicable. The monthly reports shall contain information as specified by applicable agencies

▶ Monthly submittals shall:

- describe actions which have been taken toward achieving compliance with the Consent Decree during the previous month
- include a summary of all results of sampling and tests
- identify all work plans, actions, including but not limited to, data collection with respect to work schedules and other information relating to the progress of the work
- include information regarding percentage of completion, unresolved delays encountered or anticipated that may effect the future schedule for implementation of the work, and a description of efforts made to mitigate delays or anticipated delays
- include any modifications to the work plan or schedules
- other important information, recommendations, solutions

SECTION THREE

ATTACHMENT NO. 1

APPLICANT'S PREVIOUS EXPERIENCE

PREVIOUS EXPERIENCE SUMMARY
CENTECH INTERNATIONAL LLC
920 Lakeview Lane
Casper, Wyoming 82604

Enclosure Reference	Name of Client/Address/Tel/Fax/Contact Person/Email	Title/Location/Type of Contract	Scope of Services	Quantity of Waste Handled
1	Western Water Consultants Inc 611 Skyline Road Laramie, Wyoming 82071 POC: Paul Rechard Tel: (307) 742-0031 Fax: (307) 721-2913	Centrifuge Services Contract Powder River Crude Processors Site Glenrock, Wyoming Contract No. WWC JN 93-079.6 Contract Period: 13 May 94 Contract Price:	Cleanup & centrifuge treatment of oily sludge wastes	28,000 bbl
2	Flour Daniel 907 North Polar, Suite 100 Casper, Wyoming 82601 POC: Charles Dunn Tel: Fax:	Tri-phase Centrifuge Services Rocky Mt Oilfield Testing Center Contract No. DE-AC01-92FE62316 Contract Period: 11 Sep 96 Contract Price:	Tank bottom oil sludge recovery & centrifuge treatment to produce salable oil	2,000 bbl
3	Marathon Pipeline Company 539 S Main Street Findlay, Ohio 45840 POC: R. Douglas Rogers Tel: (419) 422-2121 Fax:	Service Contract Performed Contract No. MOC97007S/MPL97006S Contract Period: 28 Jan 97 Contract Price:		
4	Chevron Production Company 1013 Cheyenne Drive Evanston, Wyoming 82930 POC: John Desh Tel: (307) 783-9324 Fax: (307) 783-9400	Environmental Centrifuge Services Waltman/Lost Cabin Fremont, Wyoming Contract No. (GO-279) 99006856 Contract Period: 01 Sep 97 - 31 Aug 98 Contract Price: $500,000.00	Provide environmental services to centrifuge tank bottoms & clean oily dirt	
5	Conoco Inc 401 South 23rd Street Billings, Montana 59101 POC: Maurice Casad Tel: (406) 255-2515 Fax:	Services Contract Conoco Inc, Billings, Montana 59101 Contract No. BREO-98-624 Contract Period: 20 Mar 98 - 20 Mar 00 Contract Price: $300,000.00	Tri-phase centrifuge services for heavy crude tank bottoms	15,000 plus bbl

PREVIOUS EXPERIENCE SUMMARY (Continued)
CENTECH INTERNATIONAL LLC
920 Lakeview Lane
Casper, Wyoming 82604

Enclosure Reference	Name of Client/Address/Tel/Fax/Contact Person/Email	Title/Location/Type of Contract	Scope of Services	Quantity of Waste Handled
6	AEC Express Holdings Inc 800 Werner Court, Suite 352 Casper, Wyoming 82601 POC: Robert Avery Tel: (307) 237-5590 Fax: (307) 237-5770	Services Contract AEC Express Holdings Inc Casper, Wyoming 82601 Contract No. AEH000207 Contract Period: 01 Mar 00 - 28 Feb 01 Contract Price:		
7	Cenax Harvest States Cooperatives Address: POC: Tel: Fax:	Services Contract Location of work performed? Contract Period: 10 Sep 01 – 09 Sep 02 Contract Price:	Tri-phase separation of tank bottoms to produce salable oil	
8	Wyoming Pipeline Company 936 Highway 450 Newcastle, Wyoming POC: Vern Johnson Tel: Fax:	Services Contract Wyoming Pipeline Butte Tank Newcastle, Wyoming Contract No. Contract Period: 20 Jun 03 – 30 Aug 03 Contract Price: $22,720.00	Tank bottom oil sludge recovery & centrifuge treatment to produce salable oil	1,080 bbl
9	TRIHYDRO Corporation 1252 Commerce Drive Laramie, Wyoming 82070 POC: Deby Forry/Jack Bedessem Tel: (307) 745-7474 Fax: (307) 745-7729	Services Contract-Remediation CheveronTexaco Refinery 75 Evans Street, Evansville, Wyoming Contract No. 04-034BA-M Contract Period: 25 Oct 04-31 Dec 04 Contract Price: $40,00.00	Centrifuge liquids from tanks to separate oil, water, and solids	2,000 plus bbl
10	EnCana Oil & Gas Inc 370 17th Street, Suite 1700 Denver, Colorada 80202 POC: Eddie Carpenter Tel: (303) 623-2300 Fax:	Services Contract EnCana Oil & Gas Properties Wyoming Contract No. Contract Period: 11 April 06-present Contract Price:		

PEREVIOUS EXPERIENCE CONTRACTS

FLUOR DANIEL

RMOTC Agreement No. 131
Job Order 650200 / 650201
Facility Code 9583

ROCKY MOUNTAIN OILFIELD TESTING CENTER (RMOTC) TESTING AGREEMENT with Centech

It is agreed this eleventh day of September 1996, by and between Centech, Inc. (hereinafter referred to as Centech), whose address is:

920 Lakeview Lane
Casper, Wyoming 82604

and Fluor Daniel (NPOSR), Inc. (hereinafter referred to as FD), whose address is:

907 North Poplar, Suite 100
Casper, Wyoming 82601

to undertake a joint field testing project, to be conducted by the Rocky Mountain Oilfield Testing Center, a unit of FD established under Department of Energy (DOE) Contract DE-AC01-92FE62316. In consideration of the agreements herein contained, the parties hereto agree as follows:

PART I - SCOPE OF WORK

1.0 Description:

1.1 The project will encompass the testing of Centech's trailer-mounted, three-phase centrifuge, which is designed to produce salable oil from tank bottoms. Approximately 2,000 bbl of tank bottoms from NPR-3 will be processed at NPR-3 test site B-3-2, at 100-150 bpd.

1.2 The project will test Centech's feed-pump system, electric submersible heater, and automated control system.

1.3 Successful testing of the process will demonstrate that: 1) the equipment and modifications operate reliably, 2) the process breaks tank bottom emulsions, 3) salable oil is produced, and 4) the system operates in a hands-off mode.

2.0 Support provided by Fluor Daniel:

2.1 Fluor Daniel (NPOSR), Inc., under the terms of its Contract DE-AC01-92FE62316 with, and on behalf of, the U.S. Department of Energy, will support the project by providing: 1) approximately 2,000 bbl of tank bottoms, 2)

applicable costs.

9.0 Suspension or Termination of Work:

Either Fluor Daniel or Centech shall suspend or terminate the testing program at any time if it appears that there is any unacceptable risk, either to personnel or to the successful completion of the testing. If the Federal Government decides to sell or lease NPR-3, Fluor Daniel will endeavor to continue and complete the test as long as conditions permit. Neither Centech nor Fluor Daniel shall incur any liability as a result of a determination that testing must be suspended or terminated.

10.0 Hold Harmless:

To the fullest extent permitted by law, each party agrees to release, defend, and hold the other harmless from and against any and all liability arising in any manner from this Agreement and Fluor Daniel's performance of testing services. The U.S. Department of Energy will assume liability for damage to, or loss of, wells and other field installations used in conducting the test.

11.0 Safety:

Centech shall ensure that all project participants who work on or visit the site receive a copy of "Environmental, Safety and Health Policies and Regulations for Subcontractors" which will be provided by Fluor Daniel and that each participant is directed to observe the safety precautions outlined in this document.

12.0 Assignment to Successor Contractor:

This agreement may be assigned to a successor prime contractor at the expiration of the contract term of Fluor Daniel's contract with DOE or earlier termination thereof.

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the day and year below written, but effective as of the day and year first set forth above.

Fluor Daniel (NPOSR), Inc.
907 N. Poplar, Suite 100
Casper, Wyoming 82601

By Charles S. Dunn

Name Charles S. Dunn

Title General Manager

Date 9-13-96

Centech, Inc.
920 Lakeview Lane
Casper, Wyoming 82604

By Neal Miller

Name Neal Miller

Title President

Date 9-12-96

WASTE OIL CONSOLIDATION PROPOSAL

SALT CREEK - LACT #5

July 5, 1989

Prepared By: E.R. Reese

P.O.I. Salt Creek

INTRODUCTION

Over the course of my career here at Salt Creek, I have had the opportunity to try my hand at processing waste crude at a few different facilities. Each facility was set up differently and theory on crude processing varied also, depending on which crew you were on, so the success on recovery varied also.

In the spring of 1989, I became involved in waste crude recovery under the supervision of Danny Morse. Depending on the quality of the crude, my success on the recovery varied also. I observed that Lact #5 would be an ideal battery to set up as a main crude processing facility for Salt Creek. Lact #5 has a 6700 bbl gunbarrel that currently isn't in use and the mechanics of the producing 6700 bbl gunbarrel allow very little emulsifing of the fluids being introduced into it. Also, with the installation of a line heater in the two 1000 bbl crude tanks we are able to process year around.

So after seeing that Lact #5 indeed could be operating as the main crude processing point for Salt Creek with a few modifications, I began to investigate all the principles involved. I saw that we could consolidate all the waste oil to Lact #5 and treat it with, as mentioned before, a few modifications. But I soon discovered that there was a major "stopper" involved. We could consolidate but the efficiency or the percentage of crude recovered would be very low.

Due to the amounts of fine iron found in the waste oil, recovery becomes very time consuming and what oil can't be recovered usually ends up as road oil. It was very clear that we were throwing away a fortune in oil profits because of inefficient recovery methods.

In the past weeks I have been gathering data, information, and looking into equipment that could drastically increase our efficiency in waste oil processing. Hopefully I can convey this information in the following pages in a clear and concise manner.

CURRENT RECOVERY METHODS

Currently throughout Amoco's Salt Creek field each battery has their own set up for waste crude recovery. By various techniques, heat, chemical, and retention time, all facilities process various amounts of waste crude. All facilities generally have a few things in common, low recovery percentages and treating the same oil over and over again.

I'll give a brief review of how the other facilities handle their waste crude and then go into depth on how Lact #5 processing is handled since I'm processing there currently.

Lact #11

Tank bottoms are recycled into a 3000 bbl, mini-gunbarrel and then chemically treated, the good oil floats over and is mixed with produced oil and is sold. The interface from the mini is trucked to Lact #13 disposal pit. Also production pits are skimmed and trucked to Lact #13 disposal pit. So the majority of the waste crude (interfaces, pit oil) is trucked off.

Lact #13

Here at Lact #13 they treat waste crude with a system consisting of two 500 bbl tanks, heat, and chemical. They pull oil from their disposal pit and tank bottoms and have some success on recovery. Due to Lact #13's high volume of produced fluid the battery is prone to upsets unless the processed crude is added to the system at pipeline quality. Also portions of the treated tanks that the BSW content can't be lowered sufficiently goes back into the disposal pit to be retreated. So here once again we have the same oil being retreated time again.

Lact #10

Basically all of the waste crude from pits and tank bottoms are brought over to Lact #5.

Lact #1 & #4

These batteries don't reclaim waste oil per se, Mr. Trantham said they reclaim to a certain extent, but their tank bottoms, slop oil, interfaces, and pit oil is trucked to the Lact #5 disposal pit.

Lact #5

Here at Lact #5 the majority of the waste crude reclaiming is done. We have two 1000 bbl heated reclaim tanks, circulating pumps, sprinkler system, and pipework that accesses us to the disposal pit.

When we start to process a tank it is filled via the pump from the disposal pit or it is trucked direct to the tank. The tank is usually cold rolled with three gallons of chemical after being filled to aid with BSW dropout while the tank is being heated. The tank is then heated for four to five days with the aid of the heating coils until it gets to approx. 140 - 150 degrees. At this point there has been sufficient BSW dropout and the bottom of the tank is pumped off leaving mostly oil and fine solids in the tank. The tank is now hot rolled with about three gallons of chemical being injected into the inlet side of the pump to aid in dropping out the fine solids and remaining BSW. After approx. four hours of rolling the tank the pump is shut off and the fluid is heated to approx. 180 degrees. When the fluid reaches this temperature we have a lot of turbulence in the tank so the heat is redirected to another tank and the fluid is allowed to cool and settle for a couple of days for BSW to drop to the bottom of the tank. After the tank has cooled, depending on the quality of fluid we started with, we are basically ready to pump down the tank and put the oil which is 1% BSW or less (our cut-off point) back in the production system. But if there is a high concentration of fine solids in the oil, those which are lighter than the fluid in which they are suspended in, additional treating by means of sprinkling chemical and water on top of the fluid is neccessary. By repeatedly sprinkling the fluid additional BSW dropout is sometimes achieved. After we are done completely treating a tank we begin pumping fluid from the bottom of the tank and doing grindouts to determine the quality of the oil. We continue to pump fluid from the tank until the BSW content of the fluid is 1% or less. When the fluid is 1% BSW or less it is then pumped to the production manifold.

The percentage of oil recovered is somewhat determined by the quality and content of fine solids that we start with. The straight disposal pit oil is the hardest to treat since it has the most fine solids in it. Also we re-treat oil that has come off a processed tank that we feel is too good for road oil, usually this oil is from 5% to 50% fine solids. This is how we retreat the oil over and over again.

Time and chemical are also factors involved in the low recovery process. We usually spend 7-10 days heating and treating approx. 900 bbls of fluid. Usually 10-15 gallons/minimum of chemical at $10 to $12 a gallon are used per 900 bbl. of fluid.

But the biggest problem is still the fine solids suspended in the oil after treating. It is not uncommon for 600 bbl of the tank being processed to be between 5% - 20% fine solids (see diagram). Even after the above process has been implemented the fine solids do not drop out. We end up with oil that we can't sell, but is just too good to oil roads with. So you see if Lact #5 was made the main waste crude processing facility for Salt Creek "as is", we could handle the volumes with the addition of a few more tanks, but the percentage of crude oil recovered would remain low. Also I think too many manhours would be put in to an inefficient system.

PROPOSED RECOVERY SYSTEM

I believe we can turn the tide so to speak on crude oil processing here at Salt Creek! We can modify Lact #5 slightly and with the addition of a 3-phase decanter centrifuge we can make crude processing very efficient and only handle the fluid one time during the reclaim process (see diagram).

The fluid could be trucked into a large holding tank,possibly we could use the 5000 bbl gunbarrel from Lact #1 when it is dismantled this fall. I believe we would need a tank of this size when we saw the amount of incoming fluid being received. The trucks could either drain their water off and put mostly oil in the tank or we put all the fluid in and process the water also.

From the holding tank the fluid would be moved into the heated 1000 bbl crude tanks to be heated and mixed so all the fluid was basically the same consistency. We would need to add more coils to the crude tanks to decrease the heating time,(the fluid in the coils is only losing 20 degrees as it goes in and then comes out of the tank.) If needed to handle the volumes of incoming fluid, we could use the two 500 bbl crude tanks at Lact #13 to heat and mix the fluid.

Once the fluid was heated and mixed it would be moved via a variable speed pump into the 3-phase centrifuge. The centrifuge would separate the fluid into oil, water, and solids. The water would be discharged into the production pit, the solids into a bin or hopper, and the oil would be piped into a small tank equiped with a pump and floats to return the oil to the production manifold.

WASTE OIL AVAILABILITY

To get an understanding of how much fluid we would be handling with a Lact #5 central waste processing system and to see if spending the capitol was feasible. I traveled around the field and inventoried the amount of waste oil available for processing. I also did some grindouts to determine the percentages of oil we were putting on roads, sending back to the disposal pit, and sending to the production pit with the water. I also did grindouts on the heat treated oil to see if we were dealing with any emulsions that wouldn't break under centrifugal force.

According to the pumpers and supervisors these are the approximations of waste crude that are trucked off each month.

Lact #11

Pad from mini gunbarrel (330 bbl every 2 wks)	600 bbl per month
Prod pits (180 bbl week)	720 bbl per month
Total	1320 bbl per month

Lact #13

Lact #13 recycles to their own tanks and pit so it's difficult to estimate available fluid at this facility. On their disposal pit I would estimate there is approx. 5000 to 6000 bbl of workable fluid.

Prod pit (90 bbl a week)		360 bbl per month

Lact #4

700 to 800 bbl off bottom of settling tank every 10 to 15 days		1500 bbl per month
Bottom of reclaim tank		80 bbl per month
Prod pit (200 bbl per week)		800 bbl per month
	Total	2380 bbl per month

Lact #1

Slop tank (200 bbl every 10 to 15 days		400 bbl per month
Settling tank bottom		150 bbl per month
Prod pit		25 bbl per month
	Total	575 bbl per month

Lact #10

Pit tank		400 bbl per month
Tank bottoms		200 bbl per month
	Total	600 bbl per month

Lact #5

Prod pit		200 bbl per month
Tank bottoms		150 bbl per month
	Total	350 bbl per month

Lact #5 has an estimated 3000 to 4000 bbl of workable fluid on the disposal pit.

Total from Lact's for misc. hauling	5575 bbl per month

I also talked to Bob Wert, Jim Malson, and Bob Tipton (Larson Oilfield) and asked for a weekly average of fluid hauled that was mostly oil from workover pits and other misc. field pits. This excluded trucking from the Lact facilities. A conservative estimate would be approx. 100 bbl each weekly.

1200 bbl per month

This would bring the total from the Lact's and misc. hauling to approx.

6775 bbl per month

In 1988 at Crew #2 we treated 10,470 bbl at the crude oil processing facility. We also put 13,765 bbl of crude oil on the road last year. At Lact #13 there were 6,139 bbl treated at their facility and Mike Sowers quoted me a conservative estimate of 12,000 bbl that was taken from the disposal pit and put on the roads. This pretty much covers the availability of processable fluid. I tried to keep the figures conservative. Keep in mind these figures were for fluid that was mostly oil.

I did some grindouts of the fluid in the crude tanks during processing to determine the oil percentages and to see how the solids seperated under centrifugal force. This first sample was disposal pit oil and came from the bottom third of the tank after I had drained off the water. The tank was heated to 145 degrees at the time of the grindout. I was also testing to see how much retention time an average sample of processed crude needed to spin out solids and water under centrifugal force.

	Solids	Water
15 sec	7%	9.3%
30 sec	3%	9.6%
1 min	3%	13.0%
2 min	3%	18.0%
3 min	3%	18.0%
4 min	3%	18.0%

I ground out the top half of the sample after the 4 min. grindout and it was a trace solids.

Just out of curiousity I ground out the bottom of a tank of pure disposal pit oil to see what percentages of oil were in it. This is fluid that is usually disposed of on roads or in production pits.

GREEN WATER

	Solids	Water	Oil
1 min	3.5%	81%	10% - 15%
4 min	3.5%	81%	10% - 15%
PAD			
1 min	2.0%	73%	25%
4 min	2.5%	71%	27%
OIL (Just above pad)			
1 min	1.0%	29%	70%
4 min	2.5%	27.5%	70%

I ground out the top half of the above sample for 5 min. after the 4 min. grindout and the result was 1% solids.

CENTRIFUGE INFORMATION

I guess I first got started on the idea of purchasing a 3-phase centrifuge when Wayne Peterson sent three of us from Salt Creek to look at a centrifuge in operation in Bairoil. We went down to see if we could apply our small two phase centrifuge to our reclaim process here at Salt Creek. We talked to Neal Miller, the owner/operator of the centrifuge at Bairoil. He stated the oil industry had been trying two phase centrifuge processing on waste crude with no success. So that ruled out our small two phase we had in storage. This was later confirmed by Bob Foxall of Bird Inc. who looked at our centrifuge and stated that it wouldn't work for our crude oil processing.

Neal showed me his 3-phase centrifuge and we talked about the operation of it on crude oil and the results he had been having. In Bairoil they have been using him to spin solids from water and to reclaim waste oil. I asked him what kind of cut he was getting on the oil and he said he usually gets it down between 2% and 8% depending on how bad it was when it was brought to him.

I saw that we could not only raise the efficiency of our process, but also treat more fluid and recover much more oil from fluids that we normally throw away. So I had Neal Miller come down to Salt Creek and we walked through our facility at Lact #5 and did some grindouts on the pit oil. I told him that the fine iron was our biggest problem and that we couldn't seem to get rid of it. After grinding it out Neal stated that it could be spun out with centrifugal force. He stated that fine iron is lighter than the fluid it is suspended in and it usually takes gravitational force to get it out. After viewing our facility and looking at the oil samples Neal stated that a centrifuge could handle our fluids with good results. Lact #5 is basically set up for a centrifuge installation with the heated tanks and access to the pits, Neal said he didn't see where any drastic changes would have to be made upon installation.

Neal Miller has been in the business of designing and operating centrifuges for the fifteen years. He purchased a 3-phase centrifuge a few years ago and made some physical changes designed to process oil and currently is getting his designs patented. John Koltala of Amoco in Bairoil says Neal has handled everything and anything they have brought to him.

I asked Neal Miller to price a 3-phase centrifuge for our crude oil process here at Salt Creek. He said it would take about four months to build, since it would be constructed entirely here in the states. This machine would be designed with Neals patented changes in it. There is some question on the size of the machine we would need for Salt Creek, but I believe once we saw what the machine could do we would not want to have started out undersized.

The machine he quoted me is a high temperature stainless steel, counter current centrifuge with the backdrive unit included. The cost would be around $300,000. We would need to buy one heater and a vaiable speed inlet pump for the machine also. The heater is around $8,500 and the pump is in the neighbor-

hood of $35,000. This brings the total of the main components to approx. $343,500. The machine is rated at 100 gallons a minute or 145 bbl an hour. I doubt that we would run it that fast since we would probably slow it down some to achieve a better cut on the oil. He priced a smaller machine that is rated at 80 gal a minute or approx. 100-120 bbl an hour. This machine is also stainless steel and includes motors, hydraulic unit, and high temperature bearings. Delivery would be 14-16 weeks and he quoted me a price of $232,000. He stated that judging by what he had seen of our crude oil that we should cut no worse than 7% with one of his machines. The maintance on the machine was estimated by Neal to be around $3000 a year. The above machine would have a 1 year warranty. I asked Neal if we could hire him as a consultant to train us if we purchased a machine and he said there would be no problem with that.

PAYOFF

To come up with a payout on the centrifuge I used the amounts of fluid that are currently being trucked to reclaim facilities and to our disposal pits. I believe these are conservative figures since they don't take in all waste oil being generated in the field.

With the figure of 6,775 bbl of fluid being trucked monthly from the Lact's and pits, I would estimate the oil recovery to be in the neighborhood of 40% - 60%. Tank bottoms vary in oil content, but the trucks usually pump until they get to good oil, so we end up with some pretty good oil being processed also. Production pit oil seems to generally be high in oil content. As an estimate for payout purposes, I believe 40% of the 6,775 bbl misc. trucked fluid is recoverable.

6,775 bbl x 40% = 2,710 bbl x $18 bbl = $48,780 recovered per month

$350,000 divided by $48,780 = 7.1 month payout - on 100 gal/min machine

$232,000 divided by $48,780 = 4.7 month payout - on 80 gal/min machine

The economics of the centrifuge would increase also as we found other ways to utilize it as I will mention later.

In 1988 we put 25,000 bbl of fluid on the roads in the Salt Creek field. I believe oil recovery on this fluid with a centrifuge would have been approx 60%.

25,000 bbl x 60% = 15,000 bbl x $18 bbl = $270,000 worth of oil on the roads at Salt Creek.

CENTRIFUGE APPLICATION

The main use of the centrifuge would be for waste oil recovery. It would enable us to stop recycling iron from facility to facility and process our waste crude efficiently. We would be recovering all the oil in fluids we were working instead of part of it.

When drilling and workover activities increase in the field so will the amount of waste crude. The centrifuge allows us to handle increases in waste crude volumes without bogging down the process with having to try to process too much too fast.

With the application of a centrifuge here at Salt Creek we could set up a Lact tank maintance program. Iron is very detrimental to our gunbarrel probe control system, we could set up a schedule where gunbarrel interfaces and tank bottoms could be trucked to the waste oil facility and be processed. I think this would help us have fewer gunbarrel upsets throughout the field.

In the future I can see the different government agencies putting tighter control on the fluids that we emit down the drainages locally. This is already happening at Bairoil and I would guess it is coming up in the future for us here at Salt Creek. The centrifuge is also able to remove solids from water.

In summary the centrifuge would make oil reclaiming a very efficient and profitable process. The machine would pay for itself within one year. Oil recovery would be more profitable than it has ever been and we would'nt be oiling roads with oil we had nothing else to do with. I believe the government will be forcing us to look at this option in the future, so I think we should act now and profit by doing so.

MidContinent Business Unit
North America Upstream
PO Box 36366
Houston, TX 77236
281-561-3468

Daryl Wilson
Contract Administrator

Sent
2-8-03

ChevronTexaco

December 10, 2002

Centech Inc

920 Lakeview Lane

Casper, WY 82604

***Re: GO-279 Contract No.* 99006856**

Dear Supplier:

The purpose of this letter is to propose that the term of the referenced contract, now held by ChevronTexaco Exploration & Production Company, a division of Chevron U.S.A. Inc., shall continue in force until terminated by either party on 30 days written notice. If you are agreeable to the foregoing, please sign in the space provided below and return the original of this letter within 15 days after receipt.

If you have any questions, please contact Kathy Peacock at 281-561-3528.

Sincerely,
Daryl Wilson

AGREED AND ACCEPTED:

Centech Inc

By: Paul Miller

Title: Pres

Date: 1-2-03

+

50020085

Contract

ServiceORDer 4507515

[redacted]

Chevron U.S.A. Production Co., a Pennsylvania corporation, hereafter referred to as COMPANY, and the undersigned, hereafter referred to as CONTRACTOR, hereby agree on 9/1/97, 19 , that CONTRACTOR shall perform for COMPANY, at or near Waltman/Lost Cabin, County of Natrona/Fremont, State of Wyoming the work set forth in Specification No. N/A, dated 9/1/97 and entitled

Provide environmental services to centrifuge tank bottoms and clean oily dirt.

all in accordance with the above Specification and the Attachments and Exhibits listed on the reverse side hereof, all of which shall constitute the Agreement of the parties hereto. The Provisions Of Exhibits attached hereto and made part of this agreement.

COMPANY shall pay CONTRACTOR, in accordance with the Terms and Conditions of the Agreement, the following compensation: Contractor's rate schedule dated: Contractor's total compensation shall not exceed $500,000.00 (Five hundred thousand dollars and no/cents), without prior written company authorization.

The work shall be commenced on 9/1/97
diligently prosecuted, and completed by 8/31/98

A payment and performance bond in terms and executed by a surety company satisfactory to COMPANY shall be furnished to COMPANY in the sum of $0

(No bond required unless an amount is entered above.)

CONTRACTOR CENTECH, Inc.

By Neal Miller

Title Pres.

Witness Susan R. Miller

CONTRACTOR's State License No. Wyo. use Tax
(Where required by State Law) 01-0-02066

Communications to CONTRACTOR should be addressed to the attention of:
Neal Miller
CENTECH, Inc.
920 Lakeview Lane
Casper, WY 82604
(307) 265-7621

COMPANY Chevron Production Co.

By John B Desch

Title OPERATIONS SUPERVISOR

CONTRACTOR's Taxpayer I.D. No. Fed # 45-0397962

Communications to COMPANY should be addressed to the attention of:
John Desch
Chevron Production Co.
1013 Cheyenne Drive
Evanston, WY 82930

Facility Completed	Superintendent or Foreman

Invoice No.	Date	Amount	Date Received	Charge Account No.	Job No.

Remarks

ChevronTexaco Exploration Production Co.
MID-CONTINENT SBU
1013 Cheyenne Drive
Evanston, Wyoming 82930
Tel 307-783-9324
Fax 307-783-9400
LloydRobison@chevrontexaco.com

Lloyd E. Robison
Senior Safety Specialist

ChevronTexaco

May 27, 2003

Dear Contractor,

Thank you for attending the Contractor Safety meeting that we held in March. I hope that you found it informative. During the meeting we promised to send the Power Point presentation used during our meeting. Since it was too large to send by e-mail we have put the presentation on CD. It is in several parts, all of which are linked to the main document (Wyoming Presentation.ppt). For the hyperlinks to work properly in Power Point you must be in the presentation view. If you have problems accessing the information on the disc feel free to call me at (307) 783-9324, or Linsey Lester at (307) 783-9365.

As we mentioned in our meetings we would like to encourage discussion within our industry on relevant safety topics. If you have any comments or questions about safety please feel free to contact your local ChevronTexaco representative, Safety specialist or me. During our meeting we discussed the need to share safety information. I collected e-mail addresses from many of you during the meeting. From time to time we will send out safety information that may be suitable for use in tailgate safety meetings with your groups.

Lloyd E. Robison
Senior Safety Specialist
ChevronTexaco

AEC Express Holdings Inc.

800 Werner Court, Suite 352
Casper, WY 82601
Tel: (307) 237-5590
Fax: (307) 237-5770

May 8, 2000

Centech, Inc.
Attn: Mr. Neal Miller
920 Lakeview Lane
Casper, WY 82604

SUBJECT: Basic Service Contract #AEH000207

Dear Mr. Miller:

Enclosed is a fully-executed original of our Basic Service Contract #AEH000207. We look forward to doing business with your company.

Yours truly,

AEC Express Holdings Inc.

Roscoe Hill

Roscoe Hill
Procurement Coordinator

BASIC SERVICE CONTRACT

THIS BASIC SERVICE CONTRACT effective as of the 1st day of March, 2000, is entered into

BY:

AEC EXPRESS HOLDINGS INC., a Delaware corporation having an office in the City of Casper, in the State of Wyoming,

(hereinafter referred to as "Company")

AND:

Centech, Inc.

(hereinafter referred to as "Contractor")

The purpose of this Contract is to state the terms and conditions under which Contractor will be providing certain basic services to Company, not related to core pipeline operations (non-DOT regulated services or work, hereinafter referred to as "Work"). In consideration for Work to be performed by Contractor during the term of this Contract, and in consideration of the funds Company will pay Contractor such Work, the parties agree to the following:

ARTICLE I – CONTRACT SCOPE AND CONTRACT DOCUMENTS

A. The following Contract documents together constitute this Contract:

Article I to XIX, inclusive
Exhibit A-1 – Sample Work Order form
Exhibit A-2 – Sample Change Order form
Exhibit B – Contractor's Labor and Equipment Rate Sheet
Exhibit C – NOT APPLICABLE; NOT ATTACHED
Exhibit D – Year 2000 Compliance Warranty
Executed Work Order, Purchase Order, and Change Order forms that specifically reference this Contract and are to be considered part of this Contract.

B. In the event of any conflict, inconsistency, or ambiguity between the Articles hereof and any of the other Contract documents referred to above, the Articles shall prevail.

C. In the event of any conflict, inconsistency, or ambiguity between any of the other Contract documents, Company shall determine which document shall prevail.

D. This Contract shall constitute the entire agreement and understanding between the parties as to Work to be performed and shall supercede all prior communications, correspondence, and terms and conditions, including those published within any price list or schedule. This contract shall govern all Work Contractor agrees to perform, and shall define the rights, liabilities, and obligations of Company and Contractor during the term hereof. However, this Contract does not obligate Company to order Work from Contractor, nor does it obligate Contractor to accept such orders.

E. This Contract may be amended or modified only by written amendment to the Contract signed by both parties. Additional or different terms or any attempt by either party, through a work order, purchase order, report, price schedule, invoice, or other document, to vary in any degree any of the terms of this Contract shall be deemed void and shall be rejected, unless this provision is expressly waived by the other in an Amendment executed as specified herein.

ARTICLE II – TERM AND TERMINATION

A. Term – The term of this Contract shall be for a period of one (1) year commencing the effective date indicated above and shall continue thereafter from month to month until terminated by either party giving not less than thirty (30) days' prior written notice. If this Contract is issued for a specific project, this Contract shall terminate upon satisfactory completion of the Work, as determined by an authorized Company Representative.

C. Attorneys' Fees - Except as provided hereinabove in Article XIV (Indemnities and Liabilities), if any suit or action is instituted to interpret or enforce any term of this Contract, the party not prevailing in such action or suit shall pay to the prevailing party such sums as the court may adjudge reasonable as attorney's and expert fees at the trial or on appeal of such action in addition to court costs and all other sums provided by law.

D. Successors and Assigns - Contractor shall not assign its interest in the Contract nor any monies to become due hereunder without the prior written consent of Company. All covenants and agreements herein contained shall extend to and be binding upon the successors and assigns of Contractor and Company.

E. Notices and Communications - Any notice, communication, or statement required or permitted to be given hereunder shall be in writing and deemed to have been sufficiently given when delivered in person or by registered or certified mail, return receipt requested, or by facsimile to:

Company at:

AEC EXPRESS HOLDINGS INC.
800 Werner Court, Suite 352
Casper, Wyoming 82601

Attention: Procurement Coordinator
Telephone: (307) 237-5590
Facsimile: (307) 237-5770

Contractor at:

Centech, Inc.
920 Lakeview Lane
Casper, WY 82604

Attention: Neal Miller
Telephone: 3072657621
Facsimile:

and shall be deemed to have been properly given:

(1) in the case of delivery, when delivered to the party to whom it is addressed; or
(2) when given by facsimile, at 9:00 a.m. local time on the day following the date that transmission has been confirmed complete.

Either Company or Contractor may change its address by giving written notice to the other in accordance with this paragraph.

F. Conflicts of Interest - Contractor shall not enter into any business, contractual, fee, rebate, or gift arrangements which would adversely affect Company or constitute a conflict of interest with respect to Work performed under this Contract or with respect to Contract negotiations occurring prior to the term of this Contract. Additionally, if any violation of this section occurring prior to the date of this Contract or the rendering of Service hereunder resulted directly or indirectly in Company's consent to enter into this Contract with Contractor or Company's request for Work hereunder, Company may, at its sole option, terminate this Contract or request for Work at any time and, notwithstanding any other provision of this Contract or request for Work, pay no compensation or reimbursement to Contractor for any work done after the date of termination, including, but not limited to, demobilization.

G. Remedies - In addition to any remedies the parties may have at law, equity, or otherwise, the parties may, by mutual agreement, choose to resolve any dispute arising under this Contract through alternative dispute resolution procedures, or, through arbitration conducted in accordance with Construction Industry Arbitration Rules of the American Arbitration Association.

IN WITNESS WHEREOF, Contractor and Company have caused this Contract to be executed by their duly authorized representatives, the day and year first above written.

Neal Miller
Signature of Contractor Representative

Neal Miller
Print Name

Pres.
Title

45-0397962
Taxpayer Identification Number

AEC Express Holdings Inc.

Signature of Company Representative

Robert Avery
Print Name

MGR- US Operations
Title

Section 10 - Contract

10.1 This AGREEMENT, along with the referenced Rate Schedules and required submittals, form the entire CONTRACT and are a part thereof as if hereto attached or herein repeated. This CONTRACT and referenced attachments may be amended only by written agreement by both the CONTRACTOR and the ENGINEER.

10.2 This CONTRACT shall be governed by the laws of the State of Wyoming.

IN WITNESS WHEREOF, the parties hereto have caused this AGREEMENT to be made and executed as of the day and year written above.

Western Water Consultants, Inc.

Paul A. Rechard ______________________ May 12, 1994
Paul A. Rechard, P.E. & L.S. Date
President

CONTRACTOR: Neal Miller

BY: Neal Miller
Name

President
Title

May 13, 1994
Date

WITNESS: Susan R. Miller (Seal if by Corporation)

Serving Our Clients Since 1980

WESTERN WATER CONSULTANTS, INC.

Engineering • Hydrology • Hydrogeology • Waste Management • Construction Administration

611 SKYLINE ROAD, P.O. BOX 4128 • LARAMIE, WYOMING 82071 • (307) 742-0031 • FAX (307) 721-2913

January 26, 1995

Mr. Neal Miller
Centech Inc.
920 Lakeview Lane
Casper, WY 82604

RE: Powder River Crude Processors Site
WWC JN 93-079.6

Dear Neal:

This letter serves to confirm recent conversations regarding a trial period of extended operations for centrifuge treatment at the Powder River Crude Processors Site. The trial period shall be performed in accordance with the terms and conditions of the Contractor Agreement dated May 13, 1994 and Amendment No. 1 to stated Agreement between Centech, Inc. and Western Water Consultants, Inc. except as stated below.

Terms of Trial

- The trial period shall be for 14 calendar days, beginning no later than February 6, 1995. The CONTRACTOR is encouraged to begin the trial at the earliest possible date.
- The CONTRACTOR may operate as many days within the trial period as it chooses. Hours and mode of operation should simulate CONTRACTOR's anticipated operations under long term extended operations.
- The CONTRACTOR shall not be required, during the trial period, to treat any water separated during the initial pass of feedstock through the centrifuge.
- This trial, in no way, binds the Group of Respondent Companies or the CONTRACTOR to any commitment for long term, extended operations beyond the trial period.

Method of Payment

- Daily operating minimum shall be $2,500 per day. This daily charge shall be paid to the CONTRACTOR for a minimum operation of 16 hours within a 24-hour period in

OTHER LOCATIONS

1949 SUGARLAND DRIVE, SUITE 134
SHERIDAN, WYOMING 82801
(307) 672-0761
FAX (307) 674-4265

701 ANTLER DRIVE, SUITE 233
CASPER, WY 82601
(307) 473-2707
FAX (307) 237-0828

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Centech Inc.
920 Lakeview Lane
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(307) 672-0761
FAX (307) 674-4265

701 ANTLER DRIVE, SUITE 233
CASPER, WY 82601
(307) 473-2707
FAX (307) 237-0828

Section 10 - Contract

10.1 This AGREEMENT, along with the referenced Rate Schedules and required submittals, form the entire CONTRACT and are a part thereof as if hereto attached or herein repeated. This CONTRACT and referenced attachments may be amended only by written agreement by both the CONTRACTOR and the ENGINEER.

10.2 This CONTRACT shall be governed by the laws of the State of Wyoming.

IN WITNESS WHEREOF, the parties hereto have caused this AGREEMENT to be made and executed as of the day and year written above.

Western Water Consultants, Inc.

Paul A. Rechard
Paul A. Rechard, P.E. & L.S.
President

May 12, 1994
Date

CONTRACTOR: Neal Miller

BY: Neal Miller
Name

President
Title

May 13, 1994
Date

WITNESS: Susan R. Miller (Seal if by Corporation)

Serving Our Clients Since 1980

WESTERN WATER CONSULTANTS, INC.

Engineering • Hydrology • Hydrogeology • Waste Management • Construction Administration

611 SKYLINE ROAD, P.O. BOX 4128 • LARAMIE, WYOMING 82071 • (307) 742-0031 • FAX (307) 721-2913

March 17, 1995

Mr. Neal Miller
Centech, Inc.
920 Lakeview Lane
Casper, WY 82604

RE: Agreement amendment for 24-hour operation at the Powder River Crude Processors Site
WWC JN 93-079.6

Dear Neal:

Enclosed for your signature are two executed originals of the referenced amendment. This document is identical to the draft document you have already reviewed. I have attached your revised rate schedule to make the document complete.

Please sign both originals, keep one for your records, and return the other one to us. Thanks for your help in getting this document finalized. Call if you have any questions.

Sincerely,

Susan Fields

Susan Fields, P.E.
Project Coordinator

SF:sb
Enclosures
File: 93-079-E

Corporate Procurement and
Materials Management

Marathon Oil Company

539 South Main Street
Findlay, OH 45840-3295
Telephone 419/422-2121

February 13, 1997

Mr. Neal Miller
Centech, Inc.
920 Lakeview Lane
Casper WY 82604

RE: Contract No. MOC97007S
Contract No. MPL97006S

Dear Mr. Miller,

Please find enclosed executed Service Contracts for your files.

If you have any questions, please call me at 419/421-2748.

Sincerely,

John M Graham

John M. Graham
Advanced Contracts Analyst

JMG/jls

Enclosures
cc: L D Locke

SERVICE CONTRACT NUMBER MOC97007S

BETWEEN

MARATHON OIL COMPANY

AND

CENTECH, INC.

MARATHON PIPE LINE COMPANY

SERVICE CONTRACT
Contract No. MPL97006S

THIS CONTRACT, made and entered into this 28 day of January, 1997, by and between Marathon Pipe Line Company a Delaware Corporation, having an office at 539 South Main Street, Findlay, Ohio, 45840, herein referred to as "COMPANY", and Centech, Inc. a(n) Wyoming corporation, and its subsidiaries, affiliates, and divisions herein collectively referred to as "CONTRACTOR."

WHEREAS, COMPANY proposes to have services (including any supervision, labor, equipment, materials and any other items necessary to perform the work requested); hereinafter referred to as "Work," performed under the Contract Articles and the Exhibits attached hereto, and as more particularly described in the "Work Orders" issued hereunder, (together with any additions, supplements, and amendments) all of which shall hereinafter be referred to as the "Contract"; and,

WHEREAS, CONTRACTOR is willing to perform the Work for COMPANY, subject to and in accordance with the terms and conditions set forth in this Contract, and in the applicable Work Order;

NOW, THEREFORE, for and in consideration of the terms, conditions, covenants, and agreements herein contained and of the payments to be made as herein provided, the parties hereto agree as follows.

ARTICLE 1: PERFORMANCE OF WORK

1.1 CONTRACTOR represents it is qualified to and agrees to perform the Work in accordance with this Contract. This Contract does not obligate COMPANY to order services from CONTRACTOR nor does it obligate CONTRACTOR to provide services to COMPANY, but shall control and govern all services ordered by COMPANY and accepted by CONTRACTOR hereunder, and shall define the rights and obligations of COMPANY and CONTRACTOR with regard to the matters covered hereby.

1.2 COMPANY may, from time to time, request CONTRACTOR to perform Work hereunder by issuing a Work Order to CONTRACTOR, which Work Order shall specifically detail:

1.2.1 the Work required to be performed, pursuant to the plans and specifications attached to or referenced in such Work Order;

1.2.2 the time limits within which the Work must be satisfactorily completed;

1.2.3 the basis for payment by COMPANY to CONTRACTOR in accordance with Article 20 below;

1.2.4 the location where the Work is to be performed (hereinafter referred to as "Site"); and

1.2.5 any other information which COMPANY may deem essential to the Work.

The Work shall not commence prior to execution of the Work Order by both COMPANY and CONTRACTOR. Unless otherwise specified by COMPANY, in writing, CONTRACTOR shall have five (5) business days from date of CONTRACTOR's receipt of Work Order to execute and return the unaltered Work Order submitted by COMPANY. Any unaccepted Work Order may be cancelled or revoked by COMPANY.

1.3 CONTRACTOR shall carry out the Work under this Contract and shall furnish experienced personnel, supervision, small tools, transportation, licenses, insurance, permits, bonds, services and all other things necessary or required in and for the proper and timely performance of the Work. Further, CONTRACTOR shall furnish all materials and equipment as specified in the Work Order and any materials and equipment not specifically listed therein as being furnished by COMPANY.

1.4 Work performed hereunder shall be performed with all due skill, care and diligence and in accordance with good and sound practices and to the satisfaction of COMPANY.

1.5 Regarding CONTRACTOR's performance of the Work, time is of the essence. CONTRACTOR shall complete the Work in accordance with the Contract within the time limit(s) detailed in the Work Order.

1.6 Upon request by COMPANY, CONTRACTOR shall furnish a production schedule prior to commencement of the Work.

1.7 If any fabrication work is performed under this Contract, unless otherwise specified in the Work Order, all engineering drawings will be approved by COMPANY prior to fabrication. All fabricated material may be inspected (at COMPANY's discretion) at CONTRACTOR's facility before shipment. CONTRACTOR shall notify COMPANY's representative at least five (5) working days before the inspection is required.

no effect upon all other remaining conditions, clauses, and provisions of this Contract which shall remain in full force and effect.

ARTICLE 44: SUBJECT HEADINGS

The subject headings in this Contract are for convenience only and are not determinative of the substance of the subject clause.

ARTICLE 45: GOVERNING LAW

The validity, interpretation and performance of this Contract shall be governed and construed in accordance with the laws of the State of Ohio.

ARTICLE 46: SUCCESSORS AND ASSIGNS

The covenants and agreements contained in this Contract shall apply to and be binding upon the Parties hereto, their successors and assigns and shall not be assigned by either Party without prior written consent of the other Party. Any assignment without consent shall be void.

ARTICLE 47: ENTIRE CONTRACT

This Contract and its attachments represents the entire understanding and agreement between the parties hereto and supersedes any and all prior agreements, whether written or oral, that may exist between the parties regarding the Work. No terms, conditions, prior course of dealings, course of performance, usage or trade, understandings, purchase orders, or agreement purporting to modify, vary, supplement or explain any provision of this Contract shall be effective unless in writing, signed by representatives of both parties authorized to amend this Contract.

ARTICLE 48: NOTICES

Any notice required or permitted hereunder shall be in writing and shall be deemed to have been validly given only if delivered in person or sent by registered or certified mail, postage prepaid, return receipt requested, in the case of COMPANY to: Marathon Oil Company, 539 South Main Street, Findlay, OH 45840, ATTN: Contracts Analyst - Room 3626; and in the case of CONTRACTOR to: Centech, Inc., 920 Lakeview Lane, Casper WY 82604.

IN WITNESS WHEREOF, the parties hereto have executed this contract the day and year first above written. This Contract supersedes all prior negotiations, preliminary agreements, and other writings with CONTRACTOR in connections with the subject matter hereof and is the entire final Contract between the parties.

COMPANY: MARATHON OIL COMPANY
Signed by: R. Douglas Rogers
Name Printed: R. Douglas Rogers
Title: Project Manager
Date: 2-4-97

CONTRACTOR: CENTECH, INC.
Signed by: Neal Miller
Name Printed: Neal Miller
Title: President
Date: January 28, 1997

Trihydro
CORPORATION

transmittal sheet

To:	Neal Miller	**From:**	Deby L. Forry, Esq. DF
Company:	Centech, Inc.	**Date:**	October 14, 2004
Address:	920 Lakeview Lane	**Job Number:**	200-000-017
City, State, Zip:	Casper, WY 82604	**Project Name:**	Casper
Fax:		**Re:**	General Basic Agreement & Work Order
Telephone:	307-265-7621		

Copies: 2 **We are Enclosing: Original Basic Agreement 04-034BA-M**
2 **Original Work Orders, 04-068WO-M, with Attachments A-H**

Remarks:

Mr. Miller:

Transmitted herewith are two original Basic Agreements and two original Work Orders with Attachments. If acceptable, please sign both sets of originals and return one set of originals to Trihydro Corporation for its records prior to commencing work. If you have any questions please do not hesitate to contact me at 307-745-7474 ext. 4804.

Signature: Deby L Forry

If enclosures are not as noted, please notify us at 307/745.7729

TRIHYDRO CORPORATION – CENTECH, INC.
PROFESSIONAL SERVICES
SUBCONTRACTOR -- BASIC AGREEMENT

THIS AGREEMENT, is made and entered into this 19 day of October 2004, by and between TRIHYDRO CORPORATION, a Wyoming corporation, with its principal place of business at 1252 Commerce Drive, Laramie, WY 82070 ["TRIHYDRO"] and CENTECH, INC., a Wyoming Corporation, whose address is 920 Lakeview Lane, Casper, WY 82604 ["CENTECH"].

WHEREAS, TRIHYDRO is engaged in the business of providing hydrology and environmental engineering and consulting services, and services related to environmental monitoring and remediation; and CENTECH is engaged in the business of providing professional Centrifuge services; and

WHEREAS, TRIHYDRO may from time to time require the services of CENTECH at diverse projects, the details of which are unknown at this time; and TRIHYDRO and CENTECH desire to set forth herein the terms and conditions under which such services will be provided;

NOW, THEREFORE, in exchange for mutual consideration herein, the parties agree as follows:

ARTICLE 1. SERVICES AND WORK ORDERS.

1.01 Services. During the term of this Basic Agreement, and subject to the terms and conditions set forth herein, CENTECH shall provide professional Centrifuge services as requested by TRIHYDRO and accepted by CENTECH.

1.02 Work Order. All requests for services shall be by a Work Order from TRIHYDRO in a mutually agreed form, such as Attachment A hereto. By signature of an Authorized Representative of each party, each Work Order shall be mutually agreed upon in advance of performing services. Each Work Order shall be accompanied by a Schedule of Charges and shall include the following:

(a) Identity of the contract under which work is being performed, specifying location of the project and identity of the owner of the project (the "Owner");

(b) Scope and description of the work and services to be performed ["the Work"], including plans and specifications where appropriate;

(c) Schedule for commencement and completion of work;

(d) Identifiable health and safety considerations;

1.03 Work Change Orders. TRIHYDRO reserves the right to make changes in the Work by a Work Change Order in a mutually agreed form, such as Attachment B, which shall supersede any previous Work Order; such changes shall in no way invalidate this Basic Agreement.

1.04 Additional Work. If CENTECH determines in its judgment that adequate performance of the services will require CENTECH to perform additional or different tasks or methodologies than those requested in the Work Order, CENTECH shall notify TRIHYDRO in writing before performing the additional tasks or methodologies. CENTECH shall not be entitled to any payment for extra work performed unless such work shall have been specifically authorized by TRIHYDRO on a Work Change Order. On the first of each month CENTECH shall submit to TRIHYDRO a detailed statement of amounts due for extra work, separated according to the specific Work Change Orders or other TRIHYDRO authorizations.

1.05 Plans and Specifications. Any specifications and plans attached to a Work Order are intended to be explanatory of each other. All drawings, specifications and copies thereof furnished to CENTECH are not to be used on other work and are to be returned to TRIHYDRO at the completion of the Work.

ARTICLE 2. AUTHORIZED REPRESENTATIVES. Authorized Representatives; Notices. The parties hereby designate the following Authorized Representatives, who may be changed only by written notice to the other party; all contractual notices affecting this Basic Agreement shall be sufficient if delivered in writing by certified mail to the respective parties at the following addresses:

Jack G. Bedessem or Deby L. Forry, Esq.
TRIHYDRO CORPORATION
1252 Commerce Drive
Laramie, WY 82070

Neal Miller
CENTECH, INC.
920 Lakeview Lane
Casper, WY 82604

ARTICLE 3. TERMS OF AGREEMENT AND TERMINATION.

3.01 Severability of Terms. Every part, term or provision of this Basic Agreement is severable from every other part, term or provision. A finding that any one part, term, or provision is invalid, void or unenforceable shall not affect the remaining parts, terms and provisions.

3.02 Integrated Agreement; Incorporation in Work Order. The terms and conditions set forth herein, together with particular work orders, constitute the entire understanding of the parties relative to the provision of services by CENTECH to TRIHYDRO. Without further reference, and unless otherwise mutually agreed, this Basic Agreement shall be incorporated in all Work Orders and authorizations and shall govern each particular Work Order mutually agreed upon.

3.03 Survival of Terms. The terms and conditions of this Basic Agreement as applied to a particular Work Order shall survive termination or expiration of the Basic Agreement and shall continue to govern completion of any Work Orders signed by the parties.

3.04 Non-Exclusive Agreement; No Minimum Work Amount. This Basic Agreement is not exclusive. In its discretion TRIHYDRO may engage the services of any other individual or entity to perform Centrifuge services on any project. Except where both parties agree to particular Work Orders, neither party shall be obligated to the other as a result hereof. TRIHYDRO does not guarantee CENTECH a minimum amount of work and does not guarantee or imply that any Work Order will be issued.

3.05 Non-performance. Should CENTECH fail, neglect, or refuse to perform any work under a signed Work Order; or should CENTECH become insolvent; or if at any time the Work is unreasonably delayed; or if the conditions of this Basic Agreement or the Work Order are being willfully violated, or performed carelessly, or in bad faith, TRIHYDRO may so notify CENTECH in writing, and if the faults complained of are not corrected to the satisfaction of TRIHYDRO within three (3) days from the delivery of the notice then CENTECH shall discontinue all work under the Work Order, and TRIHYDRO shall have full right to immediately arrange for completion of the Work and to recover from CENTECH damages therefor.

ARTICLE 4. CHARGES AND BILLING.

4.01 Schedule of Charges. TRIHYDRO shall pay CENTECH in accordance with the written Schedule of Charges accompanying each Work Order.

4.02 Invoices. CENTECH shall invoice TRIHYDRO monthly for work performed under the Work Orders. TRIHYDRO shall timely review such invoices and shall notify CENTECH within thirty (30) days of any disputed amounts. All undisputed amounts shall be paid no later than 7 days after receipt of payment for the Work by TRIHYDRO, provided that in no event will payment be made later than sixty (60) days after invoice date. Final invoices for authorized work shall be submitted no later than thirty (30) days following completion of work. TRIHYDRO is not responsible or obligated to pay any invoices not submitted timely under this Basic Agreement.

4.03 Dispute Resolution. Disputes relating to payment for services shall be decided by binding arbitration in accordance with the Rules of the American Arbitration Association, except for selection of the arbitrator, which shall be determined by the parties. In such event, the Arbitrator may award the prevailing party reasonable attorney's fees and costs, to include the Arbitrator's fees.

ARTICLE 5. TIME FOR PERFORMANCE, EXTENSIONS, AND DELAYS.

5.01 Timely Performance. CENTECH shall commence and complete the Work in accordance with the schedule set forth in the Work Order and shall, at all times, proceed diligently with said Work to completion. Time is of the essence of the Basic Agreement and each Work Order entered into hereunder. The Parties may specify a sum in the Work Order for each day that work shall remain uncompleted after the time specified for its completion which, if specified, shall be deducted from the amounts due CENTECH not as a penalty, but as just and liquidated damages.

5.02 Suspension of Work. TRIHYDRO reserves the right of suspending the whole or any part of the Work at any time. If the work contemplated in a Work Order is terminated or abandoned by TRIHYDRO, TRIHYDRO shall pay CENTECH for the Work performed in conformity with specifications, and in accordance with the value of work done, said payment to represent full and final payment for all work completed and for complete cancellation of contract.

5.03 Delays. If CENTECH is obstructed or delayed in the prosecution or completion of the Work by reason of the unusual action of the elements, or by reason of the abandonment of the Work by the employees in a general strike, or by reason of war, civil disorder, fire or other casualty, strikes or embargoes, or shortage of transportation facilities, or by reason of any cause beyond the reasonable control of CENTECH or TRIHYDRO, then in that event CENTECH shall have no claim for damages for any such cause or delay, but it shall be entitled to such extension of time for the completion of the Work as the TRIHYDRO Project Manager may approve as being just and proper; provided, however, that any request for extension of time must be made on a Work Change Order within one week from the time when cause for delay occurs.

ARTICLE 6. PERFORMANCE; COMMUNICATION OF RESULTS.

6.01 Standard. CENTECH shall perform the Work in a professional manner satisfactory and acceptable to TRIHYDRO and Owner, and in accordance with usual and customary standards for professional performing like services, and with the basic work description set forth in each Work Order, and in conformity with all applicable government or industrial standards and regulations.

6.02 Results. Results of CENTECH work and surveys shall be communicated to TRIHYDRO in writing, except that CENTECH may give results orally or in electronic form in advance of the final written results. Such oral or electronic communications of results in advance of the final written results are tentative only and are subject to change by CENTECH.

6.03 Site and Risk Assessment. Unless otherwise agreed in writing, prior to the execution of a Work Order, CENTECH shall make sufficient examination and tests to determine the difficulties and hazards

incident to doing the work, whether arising from the type and nature of the activity to be performed, the location of the work, conditions of the premises, proximity of the work to adjacent facilities, equipment, tanks, buildings and other structures, or otherwise, and CENTECH shall determine to its satisfaction the nature and extent of all such difficulties and hazards.

6.04 Certification. All reports and documents prepared by CENTECH will be certified in accordance with state or federal laws applicable to the Work Order under which the work is done.

ARTICLE 7. CENTECH's MATERIAL, EQUIPMENT AND EMPLOYEES.

7.01 Material, Equipment, Utilities. CENTECH shall, unless otherwise specified, provide and pay for all materials, labor, tools, equipment, light, power, transportation, and other facilities necessary for the execution and completion of the Work.

7.02 Labor. CENTECH will assume full liability for payment and/or collection of all present and future Social Security, Unemployment Insurance and/or other payroll and employment taxes or assessments imposed by law arising from employment of any person by CENTECH.

7.03 Employee Safety. CENTECH shall be responsible for the safety of its employees, and for compliance by its employees with safety rules and policies of the Owner and of TRIHYDRO, and with the reasonable requirements of Owner's and TRIHYDRO's drug use policies and procedures, if any are in effect for Owner's or TRIHYDRO's employees. CENTECH shall comply with Occupational Safety and Health Administration regulations and rules pertaining to its employees.

ARTICLE 8. LAWS AND PERMITS.

8.01 Federal, State, and Local Laws. This contract is made expressly subject to, and CENTECH expressly agrees to comply with and abide by, all applicable laws of the United States, and of the State and any government subdivision wherein the Work is be preformed, including all rules and regulations now existing or that may be promulgated under any such laws; and further, CENTECH hereby agrees to indemnify and hold harmless TRIHYDRO from any and all claims, demands or damages which may arise or accrue as a result of CENTECH's breach of this provision.

8.02 Business Licenses. Within five (5) days from the date of a Work Order CENTECH shall make proper application and take such steps as may be necessary to secure a permit or license to transact business in the state in which the Work is to be performed.

ARTICLE 9. INSURANCE AND INDEMNIFICATION.

Insurance. CENTECH shall carry ample and adequate insurance covering operations under this Basic Agreement and any Work Order, with minimum coverage as follows:

a. General Liability: $1,000,000.00, for protection against any and all loss, damage, injury and liability, including claims for personal injury, or death, property damage, and damage to the Work by theft, fire, tornado, windstorm, or other elements, howsoever caused.

b. Automobile liability: $100,000.00 per occurrence.

c. Professional Liability (errors and omissions) insurance: $1,000,000.00 coverage;

d. Such additional coverage as may be specified in the Work Order or Addendum.

9.02 Certificates. Documentary evidence of the insurance required by this Basic Agreement shall be furnished TRIHYDRO before commencing work under any accepted Work Order and shall be subject to approval of TRIHYDRO as to forms, companies and amounts. The insurance policies hereunder shall provide that notices by the insurer to the insured be given simultaneously to TRIHYDRO, and that at least ten (10) days prior to cancellation of such policies notice in writing shall be given to TRIHYDRO or the purported cancellation will be ineffective.

9.03 Indemnification. CENTECH shall indemnify, hold harmless and defend TRIHYDRO and Owner from and against any and all liabilities, claims, penalties, forfeitures, suits, and the costs and expenses incident thereto (including costs of defense, investigation, settlement and reasonable attorney's fees), which it may hereafter incur, become responsible for, or pay out as a result of death or bodily injury to any person, destruction or damage to any property, contamination of or adverse effects on the environment, or any violation of governmental laws, regulations or orders, to the extent that such damage was caused by any negligent act or omission or willful misconduct of CENTECH or its employees, agents, or subcontractors.

ARTICLE 10. GENERAL PROVISIONS.

10.01 Successors and Assigns. This Basic Agreement shall inure to and be binding upon the legal representatives and successors and assigns of the parties hereto. CENTECH shall not assign, transfer or convey this Basic Agreement or any Work Order, or any right, title, or interest, therein or any power to execute the same, to any person, company or corporation without the prior written consent of TRIHYDRO.

10.02 Confidentiality. TRIHYDRO and CENTECH shall not publish or release any information to news media, and shall exercise care to protect the confidentiality of any information disclosed to them in connection with or as a result of any work performed pursuant to this Basic Agreement. CENTECH may use and publish TRIHYDRO's name and a general description of the services provided by CENTECH in describing CENTECH's experience and qualifications to other or potential clients.

10.03 Independent Contractor. All work performed pursuant to this Basic Agreement or any Work Order shall be performed by CENTECH as an independent contractor and under no circumstances will CENTECH or its employees be considered employees or agents of TRIHYDRO or Owner. TRIHYDRO shall have no voice in the selection, discharge, supervision, or control of CENTECH's employees, representatives, or subcontractors. Except to the extent that a particular method is specified in a Work Order or in any plans or specifications accompanying a Work Order, TRIHYDRO shall not have any right to direct or control CENTECH in the method of performance or the means of accomplishing the desired result.

10.04 Governing Law. This Basic Agreement and all Work Orders shall be governed by and interpreted in accordance with the laws of, and any lawsuit hereunder shall be brought in, the state where work is being performed.

IN WITNESS WHEREOF, the parties hereto have signed this Basic Agreement in duplicate originals as of the day and year first above written.

CENTECH, INC.	**TRIHYDRO CORPORATION**
By:	By:
	Deby L. Forry, Esq.
Title: Pres	Title: Vice President of Risk Management

ATTACHMENT B

TRIHYDRO CORPORATION – CENTECH, INC.
PROFESSIONAL SERVICES
EXAMPLE WORK CHANGE ORDER

Work Order No.: ______________ Date: ______________

Job No.: ______________

Change Order No.: ______________

Location of Project:

Owner and Contract No.: ______________________________

Original Specification:

Change Order:

Attachments (if any): ______________________________

Estimated Additional Cost (if any): ______________

[Invoices requesting pay for additional costs incurred as a result of an executed Work Change Order must reference the Change Order No.]

Estimated Additional Time Required (if any): ______________________

SIGNED IN DUPLICATE ORIGINALS on the date first above written.

TRIHYDRO CORPORATION

BY: ______________________

TITLE: ______________________

CENTECH, INC.

BY: ______________________

TITLE: ______________________

ATTACHMENT A

TRIHYDRO CORPORATION – CENTECH, INC.
PROFESSIONAL SERVICES
EXAMPLE WORK ORDER

Work Order No.: ________________ Date: __________

Job No.: ___________________

Location of Project:

Owner and Contract No.: ____

Services to be Performed: ____

____

Schedule -- Commencement Date: _______________________ Completion Date: ________________

Attachments:

Schedule of Charges: ____

Plans and Specifications: ____

Health and Safety Considerations:____

Other Information:

This WORK ORDER is made and entered into pursuant to that certain Basic Agreement by and between the undersigned dated __________________ , the terms, conditions and provisions whereof are hereby incorporated herein and made a part hereof.

SIGNED IN DUPLICATE ORIGINALS on the date first above written.

TRIHYDRO CORPORATION	**CENTECH, INC.**
BY: ________________________________	BY: ________________________________
TITLE: _____________________________	TITLE: _____________________________

TRIHYDRO CORPORATION – CENTECH, INC.
PROFESSIONAL SERVICES -- BASIC AGREEMENT
WORK ORDER

Work Order No.: 04-068WO-M

Date: October 14, 2004

Job No.: 200-000-017

Location of Project: Former Texaco Refinery
75 Evans Street, Evansville, Wyoming

Owner and Contract No.: Chevron Environmental Management Company
Contract No. 99014512, Dated December 27, 2002

Services to be Performed: Centrifuge liquids from tanks to separate oil, water, and solids as requested by Trihydro personnel.

Schedule - Commencement Date: October 25, 2004
Completion Date: December 31, 2004

Trihydro's Project Manager: Kurt Tuggle
Subcontractor's Project Manager: Neal Miller

Attachments:

A. Additional Requirements
B. Trihydro Corporation Supplier Diversity Program
C. Independent Contractor Health, Environmental and Safety Guidelines
D. Drug, Alcohol, and Search Policy – General Requirements
E. Drug, Alcohol, and Search Policy – Minimum Contractor Controlled Substance and Alcohol Program Requirements
F. Minimum Record Keeping Requirements – Contract Services
G. Schedule of Compensation
H. Rate Sheet

Health and Safety Considerations: All Centech, Inc. employees must have Loss Prevention Systems certification prior to commencing work on this ChevronTexaco EMC site.

Insurance Requirements: Per Basic Agreement between undersigned parties and executed on October , 2004 and Attachment A of this Work Order.

Other Information: Cost shall be on a time and materials basis, not to exceed $40,000.00.

This WORK ORDER is made and entered into pursuant to that certain PROFESSIONAL SERVICES SUBCONTRACT – BASIC AGREEMENT, by and between TRIHYDRO CORPORATION and CENTECH, INC., dated October 19, 2004, the terms, conditions, and provisions whereof are hereby incorporated herein and made a part hereof.

CENTECH, INC.

BY: Neal Miller

TITLE: Pres

TRIHYDRO CORPORATION

BY: Deby L. Forry
Deby L. Forry

TITLE: Vice President of Risk Management

ATTACHMENT A

ADDITIONAL REQUIREMENTS

ATTACHMENT A
ADDENDUM TO WORK ORDER

Job No: 200-000-017 Date: October 14, 2004
Work Order No: 04-068WO-M

Owner and Location of Project: Chevron Environmental Management Company
Casper, Wyoming
Contract No. 99014512, dated December 27, 2002

For purposes of work to be performed under the referenced Work Order, SUBCONTRACTOR agrees as follows:

A. ADDITIONAL PROVISIONS: SUBCONTRACTOR understands and acknowledges that the work hereunder is part of the work to be performed by TRIHYDRO as Provider under that certain CONTRACT (referred to above) by and between Owner and TRIHYDRO. The terms, provisions, and conditions of said CONTRACT are by this reference incorporated herein and made a part hereof as though fully set forth, several provisions are included in this addendum but those that are not included still remain in full force and effect. SUBCONTRACTOR agrees to be bound by and abide by the applicable terms, provisions, and conditions contained in said CONTRACT and any relevant attachments.

B. PRECEDENCE: In the event of a conflict between any of the contract documents associated with the requested scope of work, they shall take precedence in the order listed:

1) Terms and Conditions of the Owner's Agreement between TRIHYDRO and Owner, incorporated herein and made a part hereof as though fully set forth.
2) Terms and Conditions of the Work Order
3) Terms and Conditions of the General Basic Agreement

C. HEALTH AND SAFETY: SUBCONTRACTOR shall perform the Work in a lawful, safe, diligent and workmanlike manner in accordance with safe practices and shall take all necessary precautions to protect persons and property from damage or injury.

1. **Site Safety:** Without limiting the generality of the foregoing, while on Owner's premises all of Owner's and TRIHYDRO's safety rules and procedures shall be strictly observed; in particular, smoking shall be limited to such locations and occasions as are specifically authorized in writing by Owner. SUBCONTRACTOR shall not perform or permit any act on Owner's premises, which involves a fire or explosion hazard without prior written consent of TRIHYDRO. The term "Owner premises" as used herein includes, but is not limited to, all land, property, buildings, structures, installations, Owner operated service stations, vehicles, equipment, aircraft, and water craft, owned, leased, or in any other manner being used by Owner for any purpose.

2. **Acknowledgment:** SUBCONTRACTOR warrants that the equipment, methods, and facilities provided by it to perform the Work are suitable to perform such Work and that all personnel are properly qualified and trained for the Work. The SUBCONTRACTOR acknowledges that it is aware of and understands the hazardous nature of the substances, which may be involved with the Work and the risks, which are presented to persons, property and the environment. SUBCONTRACTOR shall perform all Work hereunder in full compliance with all applicable governmental laws, regulations, orders and official statements of policy.

3. **Work Site:** During the course of site or construction Work, SUBCONTRACTOR shall keep a reasonable degree of order by regularly disposing of accumulated rubbish and debris and keeping areas adjacent to the job site clean and free of dirt and debris. Upon completion of Work, SUBCONTRACTOR shall leave the area clean and free of all tools, equipment, waste and rubbish.

4. **Right to Inspect:** Owner or TRIHYDRO, without in any way relieving SUBCONTRACTOR of its obligations and without assuming any responsibility, may at any time during the performance of the Work inspect or test the equipment, procedures and facilities used or proposed for use by

SUBCONTRACTOR for Work. If Owner or TRIHYDRO should determine that the equipment, procedures or facilities are unsafe or otherwise inappropriate, it has the right, but not the obligation, to stop performance of the affected portion of the Work until the condition is fully corrected; the cost of any such work stoppage shall be for SUBCONTRACTOR's account and the time for completion shall not be extended for any such work stoppage. If this condition is not fully corrected within a reasonable time, TRIHYDRO may terminate this Work Order and/or the Authorization. In no case shall TRIHYDRO or Owner be responsible for construction means, methods, techniques, sequences or procedures of for safety precautions and programs in connection with the Work, nor shall TRIHYDRO or OWNER be responsible for SUBCONTRACTOR's failure to employ such safety precautions.

5. **Reporting Requirement:** SUBCONTRACTOR shall promptly (within 24 hours) report each incident and forward to TRIHYDRO within 24 hours a written report of each incident involving injuries to or death of any person; property damage greater than $500.00 to Owner or TRIHYDRO, supplier or third party property; or any other significant incident occurring on any projects including spills, fires, notices of violation, close calls/ near misses, etc., resulting from the performance of the Work hereunder, and shall furnish to TRIHYDRO a copy of any report regarding such incident which is filed with SUBCONTRACTOR's insurance carrier. Further incident investigation, root cause analysis and corrective action reporting will be required by Owner and TRIHYDRO as it determines appropriate.

6. **Proactive Safety Program Requirement:** SUBCONTRACTOR's development and maintenance of a proactive safety program, philosophy and culture that achieves Industry Best performance are a primary consideration in obtaining future work with TRIHYDRO for projects with Owner. SUBCONTRACTOR will be required to learn, understand and accommodate the Owner's and TRIHYDRO's safety processes and requirements as a basic threshold. As an example, Chevron Products Company has implemented a behavior based Loss Prevention System. This system employs use of Safe Performance Self Assessment, Job Safety Analysis, Incident Prevention Observations, Incident Investigation and other tools that will be used by Owner, TRIHYDRO, and SUBCONTRACTOR personnel in the performance of work. It will be the SUBCONTRACTOR's responsibility to determine what additional safety processes are necessary for them based on their levels of exposure.

7. **OSHA Statistics:** SUBCONTRACTOR shall report the following safety statistics to COMPANY:

   a) SUBCONTRACTOR shall submit by the 7th day of each calendar month, for environmental consulting work performed on site under this Work Order and the General Basic Agreement the following:

   - Total number of OSHA Recordable Incidents of SUBCONTRACTOR's employees
   - Total number of OSHA Recordable Incidents of SUBCONTRACTOR's subcontractors
   - Total number of on site work hours on Owner's projects for SUBCONTRACTOR'S employees.
   - Total number of on site work hours on Owner's projects for SUBCONTRACTOR'S subcontractors
   - Total OSHA Recordable Incident Rate for SUBCONTRACTOR
   - Total OSHA Recordable Incident Rate for SUBCONTRACTOR including subcontractors (for calculating subcontractor incident rate an estimate of total hours worked is acceptable)
   - Summary of all incidents occurring on Owner's projects (OSHA Recordables, property damage, NOV's fires, spills, etc.)
   - Total number of Subcontractor Lost Work Days (LWD)
   - Total number of Motor Vehicle Accidents (MVA)

   b) SUBCONTRACTOR shall submit at the conclusion of each calendar quarter, a report detailing the following Corporate environmental consulting services safety statistics to TRIHYDRO for SUBCONTRACTOR's entire projects:

- Total number of OSHA Recordable Incidents.
- Total OSHA Recordable Incident Rate for SUBCONTRACTOR.

8. **Duty to Report:** SUBCONTRACTOR is not responsible for ensuring that Owner or TRIHYDRO's other contractors/subcontractors comply with OSHA laws and regulations. Notwithstanding the foregoing, SUCONTRACTOR shall promptly notify TRIHYDRO upon observing any unsafe conditions or behaviors of other contractors/subcontractors.

D. WARRANTIES AND GUARANTEES:

1. **Work Guarantee:** SUBCONTRACTOR agrees that the plans, designs, and specifications furnished by it under a Work Order hereto shall be prepared, and procurement and construction management services furnished by it shall be carried out in accordance with the generally accepted, current, best practices of the industry and that any cost estimates will constitute SUBCONTRACTOR's best judgment of the cost of the project.

2. **Professional Work Product Guarantee:** Prior to 12 months after the time SUBCONTRACTOR completes all Work under the applicable authorization, TRIHYDRO may reject any and all such Work or Professional Work Product which fails in any way to conform with the requirements of this Work Order. After receiving notice thereof from TRIHYDRO, SUBCONTRACTOR shall immediately proceed to correct such Work at its own cost.

3. **Mechanical Guarantees:** SUBCONTRACTOR guarantees each segment of the Facility (a) will meet the requirements of this Work Order, and (b) to be free of defects in design, material and workmanship. The guarantee shall apply to discrepancies and defects that are discovered within twelve (12) months after the date Owner takes custody of the Facility. If corrective work is performed under this guarantee, the guarantee shall also apply to discrepancies and defects in the corrective work that are discovered within the shorter of twelve (12) months after the corrected work is again placed in operation or eighteen (18) months after the corrective work is complete. These guarantee terms shall be extended for any period that a segment of the Facility cannot be operated as a result of discrepancies or defects. This guarantee shall apply whether or not designs, data or information have been provided, reviewed or approved by TRIHYDRO, but shall not apply (i) to defects caused by the Facility being subjected to conditions substantially more severe than described in this Work Order, nor (ii) to defects in design, material and workmanship furnished by vendors of material unless such vendors are affiliates of SUBCONTRACTOR or are fabricators or suppliers of bulk materials, shop-fabricated piping spools or shop-fabricated structural steel.

    a) TRIHYDRO shall notify SUBCONTRACTOR in writing, or by telephone or telex confirmed in writing, whenever Owner or TRIHDYRO discovers a discrepancy or defect covered by this guarantee. SUBCONTRACTOR shall promptly propose a method of correcting the discrepancy or defect, which meets all requirements of this Work Order and involves the least loss of operating time. TRIHYDRO, in its sole discretion, may select SUBCONTRACTOR's proposed method or any other method of correcting the discrepancy or defect. SUBCONTRACTOR shall perform the corrective work in accordance with the selected method. When required by TRIHYDRO, SUBCONTRACTOR shall perform the corrective work required to satisfy this guarantee on an overtime and/or shift work basis, and shall procure required materials using the fastest means available in order to minimize Owner or TRIHYDRO's loss of operating time. All costs incurred by SUBCONTRACTOR in meeting the requirements of this guarantee shall be at SUBCONTRACTOR's sole expense.

4. **Vendor's Guarantees:** SUBCONTRACTOR, for Owner and TRIHYDRO's benefit, shall obtain a guarantee from each of its material vendors, except vendors of bulk materials, substantially in the form stated below in which the term "Purchaser" means SUBCONTRACTOR. SUBCONTRACTOR shall not include a guarantee in quotation requests for bulk materials. Bulk materials as used above and in Section 3 means pipe,

valves, fittings, flanges, electrical wire and cables, conduit, concrete, piles, rebar, fireproofing, insulation, non-fabricated structural steel and other items of similar nature.

"VENDOR guarantees each item provided under the Agreement (a) will meet the requirements of the Agreement, and (b) will otherwise be free of defects in design, material and workmanship. As to the items originally provided, the guarantee shall apply to discrepancies and defects that are discovered within the shorter of twelve (12) months after being placed in operation or eighteen (18) months after being received at the job site. If corrective work is performed on an item under this guarantee, the guarantee shall also apply to discrepancies and defects in the corrective work discovered within the shorter of twelve (12) months after the corrected item is again placed in operation or eighteen (18) months after the corrective work is complete. These guarantee terms shall be extended for any period that an item cannot be operated as a result of such discrepancies or defects. The guarantee shall apply whether or not designs, data or information are provided, reviewed or approved by Purchaser or its successor in interest (hereinafter called COMPANY), but shall not apply to failures caused by subjecting the item to conditions more severe than those described in the Agreement or Work Order.

COMPANY shall notify VENDOR in writing, or by telephone or telex confirmed in writing, whenever COMPANY discovers a discrepancy or defect covered by this guarantee. VENDOR shall promptly propose a method of correcting the discrepancy or defect which meets the requirements of the Agreement or Work Order and involves the least loss of operating time. COMPANY, in its sole discretion, may select VENDOR's proposed method or any other method of correcting the discrepancy or defect. VENDOR shall perform the corrective work in accordance with the selected method. When required by COMPANY, VENDOR shall perform the corrective work required to satisfy this guarantee on an overtime and/or shift work basis, and shall procure required materials using the fastest means available in order to minimize COMPANY's loss of operating time. All costs incurred by VENDOR in meeting the requirements of this guarantee shall be for VENDOR's account."

a) If guarantees in such forms are not reasonably obtainable for certain items of material, SUBCONTRACTOR shall, prior to placement of the order for said items, obtain TRIHYDRO Representative's written approval of the alternate form of guarantee that is obtainable. TRIHYDRO will not unreasonably withhold approval of alternate guarantees which have terms as favorable as being offered by other acceptable bidders for the item involved. SUBCONTRACTOR shall furnish to TRIHYDRO copies of each guarantee as stated in the final order. SUBCONTRACTOR shall take such action, short of litigation, as is reasonably necessary to enforce such guarantees, but SUBCONTRACTOR shall not itself be liable as a guarantor.

E. CONSEQUENTIAL DAMAGES: Notwithstanding any other provision of this Work Order under no circumstances shall either Party or any Affiliate of such Party, or the agents or employees of any of them (the "Released Parties") be liable in contract or in tort to the other Party or any of its Released Parties for, nor shall the other Party or any of its Released Parties make claim for, any loss or damage resulting from loss of use, loss of profits or revenues, loss of business opportunity, cost of capital, loss of goodwill, claims of customers of such Party or any of its Released Parties, cost of purchased or replacement products, additional production expenses, or like items of loss or damage. Neither party shall be relieved from liability for direct damages incurred by the other and for which it is otherwise liable under this Work Order.

F. INSURANCE REQUIREMENTS: SUBCONTRACTOR shall maintain at SUBCONTRACTOR's sole cost, at all times while performing said work, the insurance coverage in the above referenced Work Order and set forth below with companies satisfactory to TRIHYDRO. Before commencing said work, SUBCONTRACTOR shall provide a certificate evidencing the coverage, and naming TRIHYDRO and Owner as additional insureds. The certificate shall

provide that any change restricting or reducing coverage or the cancellation of any policies under which certificates are issued shall not be valid with respect to TRIHYDRO until TRIHYDRO has received 30-days notice in writing of such change or cancellation. Receipt and approval of the Certificate by TRIHYDRO shall not relieve the SUBCONTRACTOR from liability in excess of coverage.

1. **Workers' Compensation Insurance and Employers' Liability Insurance** as prescribed by applicable law. This insurance shall contain a waiver of subrogation against the indemnities and an assignment of statutory lien, if applicable.

2. **Comprehensive General Liability Insurance** (Bodily Injury, and Property Damage) including the following supplementary coverages: (a) Contractual Liability to cover liability assumed under this Work Order, (b) Product and Completed Operations Liability Insurance, and (c) Broad Form Property Damage Liability Insurance. The limit of liability for such insurance shall not be less than $5,000,000 combined single limit per occurrence.

3. **Automobile Liability Insurance and Property Damage Liability Insurance** the limits of which shall not be less than $1,000,000 Bodily Injury and $1,000,000 Property Damage per occurrence. Such insurance shall extend to owned, nonowned, and hired automobiles used by SUBCONTRACTOR's employees, agents, or subcontractors in the performance of this Work Order.

4. **Pollution Liability** if performance of this Work Order requires SUBCONTRACTOR to perform environmental consulting work, SUBCONTRACTOR shall maintain Professional Liability insurance covering legal liability, including pollution liability, arising from a negligent act, error, or omission in the performance of professional services under this Work Order. The limit of liability for such insurance shall not be less than $1,000,000 per loss.

G. POLICY ENDORSEMENTS: The above insurance shall include a requirement that the insurer provide Owner and TRIHYDRO with thirty (30) days' written notice prior to the effective date of any cancellation or material change of the insurance. The insurance specified in this Work Order, Section E shall contain waivers of subrogation rights against the Indemnitees and, if applicable, an assignment of equitable or statutory lien. The insurance specified in Sections E shall:

1. Name the Indemnitees as additional insureds with respect to operations performed under this Work Order, without regard to any liability assumed by SUBCONTRACTOR under this Work Order;

2. Provide that the insurance is primary coverage with respect to all insureds and shall not be considered contributory insurance with any insurance policies of Indemnitees; and

3. Apply separately to each insured as to whom a claim is made as if each insured were the only insured.

SUBCONTRACTOR shall provide TRIHYDRO with certificates or other documentary evidence satisfactory to TRIHYDRO, of the insurance and endorsement listed in Section E to **Trihydro Corporation, 1252 Commerce Drive, Laramie, Wyoming 82070.** Acceptance of such coverages shall not constitute a waiver, release or modification of any of the insurance with any of those coverages and endorsements. Upon request of TRIHYDRO, SUBCONTRACTOR shall provide copies of insurance policies required pursuant to this Work Order.

H. RECORDS: SUBCONTRACTOR and its Subcontractors or Vendors shall maintain true and correct sets of records in connection with the Work and all transactions related thereto and shall retain all such records for at least 24 months after completion of the Work under an applicable Work Order.

I. CONFLICTS OF INTEREST: Conflicts of interest relating to this Work Order are strictly prohibited. Except as otherwise expressly provided, neither SUBCONTRACTOR nor any director, employee or agent of SUBCONTRACTOR or its Subcontractors or Vendors shall give to or receive from any director, employee or agent of Owner any gift, entertainment or other favor of significant value, or any commission, fee or rebate. Likewise, neither SUBCONTRACTOR nor any director, employee or agent of SUBCONTRACTOR or its Subcontractors or Vendors shall, without prior written notification thereof to TRIHYDRO, enter into any business relationship with any director, employee, or agent of Owner or any Affiliate unless such person is acting for and on behalf of Owner. SUBCONTRACTOR shall promptly notify TRIHYDRO of any violation of this Section and any consideration received as a result of such violation shall be paid over or credited to Owner. Additionally, in the event of any violation of this Section, including any violation occurring prior to the

date of this Work Order, resulting directly or indirectly in TRIHYDRO's consent to enter into this Work Order, TRIHYDRO may, at TRIHYDRO's sole option, terminate this Work Order at any time and notwithstanding any other provision of this Work Order, pay SUBCONTRACTOR only for that part of the Work performed prior to the date of termination. Any representatives authorized by Owner or TRIHYDRO may audit any and all records of SUBCONTRACTOR and its Subcontractors and Vendors for the sole purpose of determining whether there has been compliance with this Section.

J. CONFIDENTIALITY: During the performance of Work, it may be necessary for Owner or TRIHYDRO to make available to SUBCONTRACTOR confidential technical or business information. SUBCONTRACTOR agrees to use all such information solely for the performance of Work and to hold all such information in confidence and not to disclose same to any third party without the prior written consent of TRIHYDRO. Likewise, SUBCONTRACTOR agrees that all technical or business information developed in connection with the Work shall be used solely for the performance of Work and shall be held in confidence and not disclosed to any third party without the prior written consent of TRIHYDRO.

"Confidential technical or business information" shall mean technical or business information provided directly or indirectly by Owner or TRIHYDRO, provided such information does not correspond in substance to information (a) that was developed by and in possession of SUBCONTRACTOR prior to first receipt from Owner or TRIHYDRO, (b) that is now, or hereafter becomes through no act or failure to act on the part of SUBCONTRACTOR, published information generally known on a non-confidential basis, or (c) that heretofore was or hereafter is furnished to SUBCONTRACTOR by a third party as a matter of right without restriction on disclosure.

R.M.

~~**K. PROPRIETARY INFORMATION AND PATENTS:** Technical or business information and all other Work product developed by SUBCONTRACTOR and/or any of the personnel provided by SUBCONTRACTOR under this Work Order shall be Owner's property and may be used or transferred by Owner in any manner it finds appropriate. Any and all such Work product shall be delivered to TRIHYDRO upon request or upon completion or termination of the Work. In the event Work under this Work Order is transferred to SUBCONTRACTOR from other subcontractors, any information regarding such Work given to or received by SUBCONTRACTOR, whether from Owner, TRIHYDRO and/or the prior contractor(s), shall be Owner's property as well. To the extent permitted by applicable law, all inventions, discoveries, and improvements, patentable and unpatentable, and copyrightable materials that are made or conceived by SUBCONTRACTOR and/or such personnel arising out of Work and all patent rights and copyright rights therein, both domestic and foreign, shall belong to, and shall be assigned by SUBCONTRACTOR and/or such personnel to Owner or TRIHYDRO or its designee. SUBCONTRACTOR and/or such personnel shall promptly and fully disclose all such inventions, discoveries and improvements to Owner or TRIHYDRO and shall cooperate with TRIHYDRO or its nominee as may be reasonably required in order to obtain patent protection therefore, including the signing of assignments of inventions and patent rights therein, and the signing of any proper affidavits, declarations, patent applications and the like. The general preparation and prosecution of patent applications shall be handled by Owner or its nominee, at its own expense. During such preparation and prosecution, SUBCONTRACTOR and/or such personnel shall be consulted only on technical features that may arise. SUBCONTRACTOR represents and warrants that each of its employees and/or Subcontractors who shall be involved in the performance of the Work hereunder and/or who have access to Owner or TRIHYDRO's confidential technical information shall be obligated to SUBCONTRACTOR in a manner consistent with this Work Order.~~

L. INFORMATION PROTECTION: In performing the Services for the Owner/TRIHYDRO, SUBCONTRACTOR shall comply with Owner's Information Protection policies and procedures as set forth at Owner's Enterprise Security Architecture System website. Such policies and procedures will also apply to all Owner's employees, and are subject to change at any time.

M. GOVERNMENTAL REGULATIONS: To the extent applicable to this Work Order, the following clauses contained in the Code of Federal Regulations are incorporated herein by reference: 48 C.F.R. §52.203-6 (Subcontractor Sales to Government); 48 C.F.R. §52.203-7 (Anti-Kickback Procedures); 48 C.F.R. §§52.219-8 and 52.219-9 (Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan); 48 C.F.R. §§22.804-1 and 52.222-26 and 41 C.F.R. §60-1.4 (Equal Opportunity); 48 C.F.R. §§52.222-35 and 52.222-37 and 41 C.F.R. §60-250.4 (Disabled and Vietnam Era Veterans); 48 C.F.R. §52.222-36 and 41 C.F.R. §60-741.5 (Handicapped Workers); 48 C.F.R. §52.223-2 (Clean Air and Water); 48 C.F.R. §52.223-3 (Hazardous Material Identification and Material Safety Data); 48 C.F.R. §52.223-14 (Toxic Chemical Release Reporting); 48 C.F.R. §52.225-11 (Restrictions on Certain Foreign Purchases); and 48 C.F.R. §§52.227-1 and 52.227-2 (Patent Authorization & Infringement). SUBCONTRACTOR covenants that none of its employees, or employees of its subcontractors, who provide services to Owner/TRIHYDRO pursuant to this Standing Contract are unauthorized aliens as defined in the Immigration Reform and Control Act of 1986. SUBCONTRACTOR

shall insert the substance of the foregoing provisions of this Section into all non-exempt subcontracts or purchase orders as required.

Without limiting the generality of any other provision of this Work Order, SUBCONTACTOR also agrees (i) to comply with all the requirements of 48 C.F.R. § 52.223-2 relating to Section 114 of the Clean Air Act, as amended (42 U.S.C. 1857, et seq., as amended by Pub. L. 91-604) and Section 308 of the Federal Water Pollution Control Act (33 U.S.C. 1251 et seq., as amended by Pub. L. 92-500), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in Section 114 and Section 308 of the Air Act and the Water Act, respectively, and all regulations and guidelines issued thereunder before the award of this contract; (ii) that no portion of the work required by this Work Order will be performed in a facility listed on the Environmental Protection Agency List of Violating Facilities on the date when a request for Work is made unless and until the EPA eliminates the name of such facility or facilities from such listing; (iii) to use its best efforts to comply with clean air standards and clean water standards at the facility in which the Work is being performed; and (iv) to insert the substance of the provisions of this clause into any nonexempt subcontract, including this paragraph.

It is the policy of the United States Government, and of Owner as a contractor to the United States Government to ensure that small business concerns, small business concerns owned and controlled by socially and economically disadvantaged individuals and small business concerns owned and controlled by women shall have the maximum practicable opportunity to participate in performing contracts let by Owner. To this end, Owner/TRIHYDRO and SUBCONTRACTOR agree that, as mandated by 48 C.F.R. Section 52.219-9, governing "Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan,"

a) the clause entitled, "Utilization of Small, Small Disadvantaged and Women-Owned Small Business Concerns," set forth in 48 C.F. R. Section 52.219-8 is hereby incorporated herein, and made a part hereof, in its entirety;

b) in the event that the amount of this Work Order exceeds $500,000, prior to the execution of this Work Order SUBCONTRACTOR shall adopt a Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan similar to that adopted by TRIHYDRO, the plan of SUBCONTRACTOR is to be included in and made a part of this Work Order; and

c) SUBCONTRACTOR shall submit Standard Forms 294 and 295 as set forth in 48 C.F.R. Section 52.219-9(d)(10).

N. NONSEGRAGATED FACILITIES: The following Certification of Nonsegregated Facilities shall apply to this Standing Contract as required by Executive Order 11246 and 48 C.F.R. §52.222-21.

"Segregated facilities", as used in this Section 17.2, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise.

SUBCONTRACTOR certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. SUBCONTRACTOR agrees that a breach of this certification is a violation of the Equal Opportunity clause contained at 48 C.F.R. §52.222-26 incorporated in Work Order.

SUBCONTRACTOR further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will: (1) obtain identical certifications from proposed subcontractors before the award of subcontracts under which the subcontractor will be subject to the Equal Opportunity clause; (2) retain the certifications in the files; and (3) forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS
OF REQUIREMENT FOR CERTIFICATIONS OF
NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. §1001.

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CERTIFICATE OF NONSEGREGATED FACILITIES

"Segregated facilities", as used in this provision, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis or race, color, religion, or national origin because of habit, local custom or otherwise.

SUBCONTRACTOR certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. SUBCONTRACTOR agrees that a breach of this certification is a violation of the Equal Opportunity clause contained at 48 C.F.R. §52.222-26.

SUBCONTRACTOR further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will – (1) obtain identical certifications from proposed subcontractors before the award of subcontracts under which the subcontractor will be subject to the Equal Opportunity clause; (2) retain the certifications in the files; and (3) forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS
OF REQUIREMENT FOR CERTIFICATIONS OF
NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. §1001.

Centech Inc
Subcontractor

By [signature]

920 Lakeview Lane
Address

Title Pres

Casper Wyo. 82604
City, State and Zip

Date Oct. 19 2004

Return to:

TRIHYDRO CORPORATION

1252 Commerce Drive

Laramie, Wyoming 82070

Attention: Attention: Deby L. Forry, Esquire

THIS PAGE ENDS GO-279-2 CERTIFICATE OF NONSEGREGATED FACILITIES

ATTACHMENT B

TRIHYDRO CORPORATION SUPPLIER DIVERSITY PROGRAM

TRIHYDRO CORPORATION
SUPPLIER DIVERSITY PROGRAM

Trihydro Corporation is affirmatively committed to the fullest extent to an environment of inclusion; to eradicate all forms of prejudice within Trihydro Corporation to promote and foster complete equality of job opportunities with it to all applicants and employees regardless of race, gender, religion, age, national origin and disability; and to ensure tolerance, respect and dignity of all people. Trihydro Corporation is committed to providing fair and equal procurement opportunities for all capable and competent providers of quality goods and services. We are committed to including all qualified suppliers in bid opportunities at Trihydro Corporation without regard to race, nationality, gender, disability, age or any other category protected under applicable law.

OUR VISION

Trihydro Corporation believes in Diversity and is committed to including all qualified suppliers in bid opportunities without regard to race, nationality, gender, disability, age or any other category protected under applicable law. We strive to develop a strong base of high-quality minority-owned, woman-owned and other disadvantaged suppliers that can provide superior goods and services.

OUR MISSION

Trihydro Corporation will demonstrate and continue to enhance its commitment to Minority, Women-Owned and Disadvantaged Business Enterprises (MWDBEs) by ensuring fair and equal competition for procurement opportunities of quality goods and services. Trihydro Corporation will continue to identify and encourage the development of additional MWDBEs that will strengthen economic growth with our company.

DEFINITIONS
EQUAL EMPLOYMENT OPPORTUNITY

A. E.0. 11246, as amended by E.O. 11375 (Race, Color, Religion, Sex and National Origin)

1. If the contract is In excess of $10,000, the SUBCONTRACTOR agrees to comply with the provisions of Section 202 of such Order (the "Equal Opportunity Clause"), which clause is incorporated herein by reference pursuant to the regulations promulgated under such Order (41 C.F.R. Sec. 60-1.4(d)).

2. If the contract is in excess of $10,000, the SUBCONTRACTOR certifies that it does not maintain or provide, nor will it maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not permit nor will it permit its employees to perform their services at any location, under its control, where segregated facilities are maintained.* SUBCONTRACTOR agrees that a breach of this certification is a violation of the Equal Opportunity Clause of Executive Order 11246. SUBCONTRACTOR further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) it will obtain identical certifications from proposed subcontractors prior to the award of subcontractors exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause; that it will retain such certifications in its files; and that it will forward the prescribed notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods).**

3. If the contract is in excess of $50,000 and the SUBCONTRACTOR has more than 50 employees, the SUBCONTRACTOR agrees (a) to file annually, on or before March 31 of each year, (or within 30 days after the award of such contract if not filed within 12 months preceding the date of the award), complete and accurate reports on Standard Form 100 (EEO-1) with the appropriate governmental agency, in accordance with the regulations issued by the Secretary of Labor (41 C.F.R. Sec.60-1.7), and (b) to develop a written affirmative action compliance program for each of its establishments in accordance with the regulations issued by the Secretary of Labor (41 C.F.R. Sec. 60-1.40).

B. E.O. 11701 (Section 402-Veterans Readjustment Act of 1974)

If the contract is in excess of $10,000, the SUBCONTRACTOR agrees to comply with the affirmative action clause and regulations promulgated under such Order (41 C.F.R. Part 60-250) which clause is incorporated herein by reference pursuant to Section 60-250.22 of such regulations.

*As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color or national origin because of habit, local custom or otherwise.

**The form of the prescribed notice is as follows: NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES. A Certificate of Nonsegregated Facilities as required by the May 9, 1967 order on Elimination of Segregated Facilities, by the Secretary of Labor (32 Fed. Reg. 7439, May 19, 1967), must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually or annually). Note: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

C. Use of Minority-Owned and Women-Owned Businesses As Subcontractors And Suppliers For This Contract.

With respect to MBE's and WBE's as defined below:

(1) Target

COMPANY and SUBCONTRACTOR support the utilization and development of qualified MBE's/WBE's. COMPANY and SUBCONTRACTOR agree that SUBCONTRACTOR shall have processes in place allowing the SUBCONTRACTOR to make good faith efforts to place six percent (6%) of the total dollar amount of the SUBCONTRACTOR'S contract related purchases of services and materials from qualified MBE's/WBE's; and to seek its suppliers' commitment to place 6% of its purchase dollars relative to related services and material purchases from qualified MBE's/WBE's.

For purposes of this Contract, a Minority-Owned Business Enterprise ("MBE") or Women-Owned Business Enterprise ("WBE") shall mean a business or enterprise at least fifty-one percent (51%) owned by minorities or women, respectively, who are U.S. citizens, with the management and daily business operations controlled and operated by one or more minorities or women. For purpose of this Contract, MBE's/WBE's are defined as follows.

- MBE: Subcontinent Asian American
  Asian-Pacific American
  Black American
  Hispanic American
  Native American

- WBE: A Women-Owned enterprise (not included in the definition of MBE)

(2) Quarterly Statements

To track number (1) – Target, above, SUBCONTRACTOR will provide quarterly M/WBE statements through the utilization of the attached M/WBE Response Form. The response form will be sent to you each quarter and will need to be returned to the COMPANY Vice President of Risk Management, Trihydro Corporation, 1252 Commerce Drive, Laramie, Wyoming, Attn: Deby L. Forry, no later than one week following the end of the quarter.

SUBCONTRACTOR shall provide on the second and fourth quarters of each year a statement to the COMPANY. The semi-annual statement shall be composed of a breakdown of the results as follows: (1) A listing of the suppliers, (2) The amount expended per supplier, (3) The suppliers classified as defined above, (4) A notation as to whether or not the supplier is a certified Minority or Women-Owned enterprise, (5) The type of material or service provided by the supplier (SIC Code), (6) A description of SUBCONTRACTOR'S good faith efforts and commitment to meet the target, including internal MBE/WBE programs, involvement with local purchasing councils or other support organizations, and (7) SUBCONTRACTOR shall advise buyer in a timely manner if difficulties are experienced in achieving the agreed-to target. Such notification will allow SUBCONTRACTOR and COMPANY to mutually pursue additional sourcing opportunities. Each report will be due one week following the end of the quarter.

(3) Termination

In the event SUBCONTRACTOR, in COMPANY'S sole discretion, fails to make good faith efforts to meet the Target or to meet COMPANY'S reasonable recommendations with respect to the development of SUBCONTRACTOR'S internal MBE/WBE program, COMPANY shall have the right, at its sole discretion, to terminate this contract, in whole or in part, without liability to SUBCONTRACTOR for damages, lost profits, or costs incurred as a result of termination, except that COMPANY shall pay for goods or services which conform to contract requirements actually received by COMPANY prior to the effective date of termination of the contract.

D. Section 905 (Railroad Revitalization and Regulatory Reform Act of 1976)

1. The SUBCONTRACTOR agrees to comply with the requirements of Title 49 C.F.R. 265 Subpart B of the regulations promulgated under such Act regarding "Nondiscrimination in Federally assisted Railroad Programs" and the nondiscrimination clauses therein are incorporated herein by reference.

2. It the contract is for $50,000 or more, the SUBCONTRACTOR agrees to comply with and implement the Affirmative Action Program established pursuant to Section 265.11 of 49 C.F.R.

E. Public Law 95-507, Section 2ll, 15 U.S.C. Section 637 (Small Businesses and Small Socially and Economically Disadvantaged Businesses)

1. It the contract is in excess of $10,000, the SUBCONTRACTOR agrees to use its best efforts to provide small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals, as defined in 45 F.R. 35809, with the maximum practical opportunity to participate in the performance of such contract to the fullest extent consistent with the efficient performance thereof in accordance with the regulations promulgated by the Office of Federal Procurement Policy (OFPP), 45 F.R. 35809, dated May 28, 1980, which are incorporated herein by reference.

2. Negotiated Contracts. If the contract is in excess of $500,000, the SUBCONTRACTOR agrees to comply with the small business and small disadvantaged business subcontracting plan as set forth in 45 F.R. 35810, dated May 28, 1980, which are incorporated herein by reference.

F. Executive Order 12138 (Women's Business Enterprises Program)

1. If the contract is in excess of $10,000, the SUBCONTRACTOR agrees to use its best efforts to provide women-owned businesses, as defined at 45 F.R. 35815, with the maximum practical opportunity to participate in the performance of such contract to the fullest extent consistent with the efficient performance thereof, in accordance with the regulations of the Office of Federal Procurement Policy (OFPP) issued pursuant to this Order and appearing at 45 F.R. 35814, dated May 28, 1980, which are incorporated herein by reference.

2. Contracts over $500,000 or $1 Million for construction of any public facility. If the contract is in excess of $500,000 or $1 Million for construction of any public facility, the SUBCONTRACTOR agrees to comply with the regulations promulgated by the Office of Federal Procurement Policy (OFPP) appearing at 45 F.R. 35815, dated May 28, 1980, which are incorporated herein by reference.

CERTIFICATION

Suppliers will be required to verify MWDBE status for each contract award. The Non-Discrimination-Equal Opportunity Form is provided and referenced herein as Attachment A.

CONTACT

The Trihydro Corporation Supplier Diversity contact is Deby L. Forry, Esq. If you have any questions concerning the Trihydro Corporation Supplier Diversity Program, please contact the coordinator using the following information:

Deby L. Forry, Esq
Vice President of Risk Management
1252 Commerce Drive
Laramie, Wyoming 82070
Phone: 307-745-7474 ext 4804
Fax: 307-745-8214
dforry@Trihydro.com

EXHIBIT A
TRIHYDRO CORPORATION – CENTECH, INC.
NONDISCRIMINATION -- EQUAL EMPLOYMENT OPPORTUNITY

Work Order No.: 04-068WO-M Date: October 7, 2004

Job No.: 200-000-017

Owner:	Chevron Environmental Management Company
Location of Project:	Former Texaco Casper Refinery
Agreement Number and Date:	Basic Agreement between TRIHYDRO CORPORATION and CENTECH, INC., dated October , 2004.

For purposes of work to be performed under the referenced Work Order and Basic Agreement, CENTECH, INC. agrees as follows:

A. SUBCONTRACTOR's Compliance: During the performance of this work CENTECH, INC. will be in full compliance with Executive Orders 11246 (as amended by 11371), 11701, 11625, 11758, 12138 and the provisions of 15 USC Section 637, and with the regulations, rules and orders issued thereunder, to the extent such requirements are applicable to CENTECH, INC., CENTECH, INC. must certify his compliance by signing Certificates signifying same.

B. Information Attached: The attached copy of TRIHYDRO CORPORATION and Owner's contract supplement briefly describes the referenced Executive Orders and law.

C. Acceptance and Certification: CENTECH, INC. must indicate receipt of this Equal Employment Opportunity information and compliance, if required, by its signature:

ACCEPTED this 19 **day of** Oct **, 2004.**

Centech Inc.
FIRM/COMPANY NAME

SIGNATURE OF AUTHORIZED REPRESENTATIVE

BY: Neal Miller

PRINTED NAME: Neal Miller

TITLE: Pres.

D. Provider's Status: Please indicate by check mark if CENTECH, INC. is a:

Minority Business Enterprise ____________
Small Business Concern ____________
Small Business Concern Owned and Controlled By Socially and Economically Disadvantaged Individuals ____________
Women-owned Business Concern ____________

ATTACHMENT C

INDEPENDENT CONTRACTOR HEALTH, ENVIRONMENTAL AND SAFETY GUIDELINES

ATTACHMENT C

INDEPENDENT CONTRACTOR HEALTH, ENVIRONMENTAL AND SAFETY GUIDELINES

COMPANY is committed to providing a safe, healthy workplace for its employees and those of its contractors and subcontractors. The safety and well-being of those with whom this Company works is of paramount importance to COMPANY. Job safety is considered a critical driver in our aim to achieve operational excellence and incident-free operations through safe, reliable, efficient and environmentally sound operations.

CONTRACTOR shall comply with the following Independent Contractor Health, Environmental and Safety Guidelines when performing work for COMPANY. These guidelines are to be considered as minimum standards, These guidelines are intended to supplement, not replace, CONTRACTOR's safety program. It is CONTRACTOR's responsibility to develop and implement a program to comply with industry and COMPANY health and safety standards. CONTRACTOR's compliance with these guidelines in no way alters CONTRACTOR's status as an independent contractor or CONTRACTOR's liability and indemnity under this Contract. The term CONTRACTOR, as used in these guidelines, shall be understood to include any and all subcontractors performing work under terms of the contract under consideration.

1.00 Responsibility for Compliance

1.01 CONTRACTOR shall communicate these guidelines, as well as any other health, environmental and safety requirements provided by COMPANY, to all of its employees, subcontractors, and the employees of its subcontractors.

1.02 CONTRACTOR shall also require its subcontractors to comply with such health, environmental and safety laws, rules, regulations and standards and any other requirements specified by COMPANY in connection with the performance of work for COMPANY and shall be responsible for ensuring such compliance by its subcontractors.

1.03 Prior to the commencement of any work activity, CONTRACTOR shall provide COMPANY with the name and qualifications of its qualified representative(s) and those of its subcontractors who will be responsible for health, environmental and safety protection at the job site(s).

1.04 CONTRACTOR shall have in place a comprehensive Health, Environmental and Safety (HES) program with a strong focus on continuous performance improvement. At any time and from time to time, COMPANY may require CONTRACTOR to furnish COMPANY with a copy of CONTRACTOR's HES program together with complete details concerning the implementation of such program. COMPANY shall have the right to audit CONTRACTOR's HES program. These guidelines are intended to supplement, not replace, CONTRACTOR's HES program, for which CONTRACTOR remains responsible.

2.00 Health, Environmental and Safety Protection

2.01 Prior to the performance of work, COMPANY will tell CONTRACTOR if a site specific HES Protection Work Plan is required, the scope of the Plan, and the required submission date to COMPANY.

2.02 If required by COMPANY, CONTRACTOR shall submit a HES Protection Work Plan to COMPANY for review. The Plan shall describe the health, environmental and safety issues and risks associated with the work, and CONTRACTOR's and its subcontractors' safety and environmental programs in place to address these issues.

2.03 CONTRACTOR's HES Protection Work Plan shall be based on, and comply with, applicable laws, decrees, administrative rules and regulations, relevant COMPANY policy and operating procedures.

2.04 Prior to starting a project, CONTRACTOR's on-site manager shall participate in a safety, health, and environmental protection orientation with the designated COMPANY representative.

2.05 Prior to starting work, the COMPANY representative shall review CONTRACTOR's HES Protection Work Plan and either accept it, or return it to CONTRACTOR with notice of deficiencies. Acceptance shall be in writing and incorporated into the HES Protection Work Plan.

2.06 CONTRACTOR shall not start work without a HES Protection Work Plan, if required, that has been accepted in writing by COMPANY.

2.07 Prior to starting any work, CONTRACTOR shall perform a Job Safety Analysis ("JSA") as directed by the COMPANY. The JSA shall (i) carefully study and record each step of a job, (ii) identify existing and/or potential equipment, environmental, or action-generated job hazards, and (iii) determine the best way to perform the job to reduce or eliminate hazards. Incident Investigations and Near Loss Investigations (II/NLIs) shall be reviewed to determine if a loss or near loss has occurred during previous performance of the work, and the root cause of that loss or near loss. Lessons learned from the II/NLI(s) shall be incorporated into the JSA. The JSA shall be developed and/or reviewed by and fully understood by all persons who will participate in the performance of the work. CONTRACTOR shall, upon COMPANY's request, furnish COMPANY with a copy of each JSA and documentation showing that the JSA has been communicated to and fully understood by all workers.

2.08 CONTRACTOR shall participate in a Behavioral Based Safety Process which shall include:

a. Identification and documentation of critical safety behaviors

b. Training personnel to observe co-workers for safe (and questionable or at-risk) performance

c. Making observations of co-workers for safe (and questionable or at-risk) performance

d. Feedback after completion of the observation

e. Collection and documentation of observation and feedback data

f. Perform trend analysis

g. Action planning

h. Follow-up on action plans

All observations, feedback, and recommended corrective actions shall be in writing.

2.09 CONTRACTOR shall evaluate observations of questionable or at-risk activities in order to determine if the JSA requires modification to further mitigate risks. If modified, an amended JSA shall be provided to COMPANY before the work is performed again. CONTRACTOR shall update and document any training necessary to communicate the changes in the JSA prior to performing the work.

3.00 Entrance To Property

3.01 COMPANY will advise CONTRACTOR of security requirements imposed during travel to COMPANY facilities and while performing work on COMPANY premises. CONTRACTOR and its subcontractors shall comply with all security requirements.

3.02 Contact COMPANY Representative immediately after notification of award of a job. Arrange for pass badges for each of your employees, vehicle entry permits, and instructions on how the pass system operates.

3.03 COMPANY shall advise the CONTRACTOR AND Subcontractors as to the entrance area and/or parking facilities, if any, to be used by CONTRACTOR, their employees, agents, and Subcontractors.

3.04 The CONTRACTOR shall ensure that only those persons having authorized business in connection with the CONTRACTOR are allowed on the work site.

3.05 Whenever CONTRACTOR's property or COMPANY property on CONTRACTOR's conveyance is to be taken outside COMPANY locations, CONTRACTOR's Representative should request authorization in writing to remove such material and/or equipment. This authorization or release shall be given to the guard, if applicable, when exiting.

3.06 CONTRACTOR shall obtain an Identification Badge for all CONTRACTOR's employees requiring access to the building(s) for one month or longer, if applicable. CONTRACTOR through the COMPANY Representative shall notify Security in writing of all CONTRACTOR's employees requiring access to the building(s) for one month or less.

3.07 CONTRACTOR shall return all COMPANY identification badges and keys to COMPANY Security upon CONTRACTOR's individual employees' discontinuation of services at COMPANY's facilities.

3.08 Any lost identification badges and/or gate passes shall be paid for by CONTRACTOR and/or SUB-CONTRACTOR at the rate of One Hundred Fifty Dollars and 00/100 ($150.00) each.

4.00 Traffic and Vehicles

4.01 All CONTRACTOR and subcontractor traffic on COMPANY property shall observe the posted speed limit, or if not posted, a safe speed in light of existing conditions and shall follow any other safe driving practices as may be established by COMPANY.

4.02 Drive carefully. Observe posted COMPANY speed limits and traffic signs.

a. Speed limits will vary. Be alert for the posted speed limit for each area and drive within the limits at all times.

b. Make a full stop at all stop signs – no "rolling stops".

c. Respect barricades and roped-off areas.

d. Avoid backing up; drive forward whenever possible. Make sure backup alarms function properly.

e. Be alert for pedestrians. Many streets and other areas have considerable foot traffic.

4.03 CONTRACTOR and subcontractor-provided vehicles shall be equipped with appropriate seat belts for driver and passengers. CONTRACTOR and its subcontractors shall ensure that vehicle seat belts are always used.

4.04 COMPANY prohibits CONTRACTOR and subcontractors from using a cell phone, whether hand-held or hands-free, while driving or operating vehicles or heavy equipment. In addition, CONTRACTORS and subcontractors are discouraged from and to the maximum extent possible shall avoid, engaging in other forms of "multi-tasking" such as the use of two-way radios and pagers, eating, or taking notes while operating a motor vehicle. This policy applies when on COMPANY property or when using a COMPANY-owned or leased vehicle, rental vehicle, or personal vehicle for COMPANY business or while engaged in the operation of heavy equipment on COMPANY's premises.

4.05 Your motorized equipment shall be parked only within areas designated by COMPANY Representative.

4.06 Do not overload trucks and vehicles, and be sure that loads are properly placed and secured.

4.07 CONTRACTOR and its subcontractors shall ensure that all vehicles, cranes and rigging, vessels, and equipment they provide are maintained in safe operating condition and that operators are properly qualified, licensed and/or certified.

5.00 Smoking

5.01 Smoking is permissible only in designated areas. Smoking is prohibited in all areas containing crude oil or fuel storage, gas processing and compression equipment, and separation or treating equipment.

5.02 COMPANY shall have the right to order persons observed smoking in unauthorized areas to cease smoking, or to leave such area.

5.03 Smoking is prohibited in COMPANY-provided aircraft.

6.00 Matches and Lighters

6.01 "Strike anywhere" matches and plastic disposable lighters shall not be carried or used in hazardous areas. Safety matches are preferred, but facility or work site rules shall apply and control in case of conflict.

7.00 Work Permits

7.01 If CONTRACTOR or its subcontractor perform any hot work operations, CONTRACTOR and its subcontractors shall have a written hot work program. Before any hot work operations are conducted, CONTRACTOR and its subcontractors shall determine whether a hot work permit is required in compliance with either CONTRACTOR's, its subcontractors' or COMPANY's hot work program. If such permit is required, CONTRACTOR and its subcontractors shall properly issue or obtain such permit and shall comply with all conditions of such permit.

7.02 CONTRACTOR and its subcontractors shall have written safe-entry procedures and obtain prior approval from the appropriate COMPANY representative for any work involving entry into confined spaces, limited access vessels, or below grade pits. Under no circumstances shall CONTRACTOR or its subcontractors permit any worker to enter a permit-required confined space without a properly completed entry permit approved by the COMPANY representative. Confined spaces include, but are not limited to, storage tanks, process vessels, mud tanks, rig cellars, and open-top spaces more than four (4) feet in depth. CONTRACTOR and its subcontractors shall develop, implement and train their employees in a Confined Space Entry Program that is acceptable to COMPANY.

7.03 CONTRACTOR and its subcontractors shall ensure that a total energy deactivation system (lock-out / tag-out) is implemented while performing work on any equipment or machinery where there is a possibility of injury or property damage caused by accidental activation of that equipment or machinery. CONTRACTOR shall have a written Lockout/Tagout Program that specifies procedures for workers to secure all power sources when performing maintenance or service on equipment. Types of power include electrical, pneumatic, hydraulic, thermal, chemical and all forms of potential stored energy.

7.04 In areas that have general work permits, CONTRACTOR is required to follow the procedure in effect at the work location.

7.05 CONTRACTOR shall obtain approval from COMPANY Representative before:

a. Working on existing equipment

b. Using a torch, spark generator, electrode, melting pot, forge, electric motor, soldering iron or any open flame.

c. Closing walkways, roads or restricting traffic. (Proper warning signs shall be used.)

d. Using utilities such as compressed air, steam, water, or electricity.

e. Sandblasting, grinding, or spray painting.

f. Storing flammables, such as gasoline, oils, paints. Oxygen and presto bottles, etc.

g. Walking or working upon any roofs over buildings or equipment.

h. Working any time at variance with the regular schedule agreed upon at start of job with COMPANY Representative.

i. Disposing of rubbish, scrap materials, and materials left over from job.

j. Expected material deliveries.

k. Repairing equipment on COMPANY property.

8.00 Pressure Testing

8.01 CONTRACTOR and its subcontractors shall not test pipes or pressure vessels using compressed air or gas or service fluid, except after prior approval from COMPANY.

9.00 Equipment

9.01 CONTRACTOR personnel shall not operate equipment nor open or close any valves, switches, or electric circuits except after prior notice to COMPANY.

10.00 Explosives and Hazardous Materials

10.01 If CONTRACTOR or its subcontractors require the use of explosives in performance of the work, they shall provide COMPANY with written notification regarding the proposed use, storage and handling of such explosives prior to the start of the blasting operations, and shall ensure that the blaster is properly qualified for the type of work being done.

10.02 CONTRACTOR and its subcontractors shall ensure the safe and proper environmentally sound storage, transportation, identification, security and handling of hazardous materials used in performance of the work while under their charge or control.

10.03 CONTRACTOR shall consult with COMPANY, before undertaking any services hereunder, concerning the existence and location of asbestos-containing materials in the Building. If CONTRACTOR is notified that asbestos containing materials are indeed in the Building, CONTRACTOR shall become familiar with its location, character and potential hazards and promptly educate CONTRACTOR's employees concerning same. CONTRACTOR shall provide documentation of such training to COMPANY. CONTRACTOR shall also execute and deliver to COMPANY, COMPANY's standard letters requiring CONTRACTOR to follow certain additional laws regulations and procedures concerning asbestos. If CONTRACTOR's employees, agents or subcontractors shall encounter a situation whereby asbestos containing materials have or may become loose, delaminated or otherwise dislodged, CONTRACTOR shall immediately cordon off the area and notify COMPANY. CONTRACTOR shall follow this notice up with a written report as required by the COMPANY. CONTRACTOR shall not in any manner attempt to clean up or otherwise disturb material, which CONTRACTOR believes may contain asbestos. CONTRACTOR shall communicate only with representatives designated by the COMPANY regarding the matter involving the alleged asbestos, unless the COMPANY requests the CONTRACTOR to do so, or applicable law requires the CONTRACTOR to do so, or the CONTRACTOR reasonably believes that the situation is an emergency.

10.04 CONTRACTOR and its subcontractors shall maintain Material Safety Data Sheets (MSDSs) for all chemicals and other hazardous materials used in performance of the work, and shall perform all work consistent with the use specifications and other information in such MSDSs. MSDSs shall accompany chemicals and other hazardous materials at all times.

10.05 All chemicals and other hazardous materials used in performance of the work shall be maintained in their original containers or other containers properly labeled in accordance with OSHA HAZCOM requirements and other state or local requirements. Water supplies shall be labeled "potable" or "non-potable" as appropriate.

11.00 Ladder Safety

11.01 The following practices apply when ladders are used in the performance of work:

a. Face the ladder and have both hands free.

b. Do not overreach, and never slide down the ladder.

c. Keep soles of shoes free from excessive oil or water.

d. Do not step on any rung or step higher than the third from the top of any portable stepladder.

e. Never place a ladder in front of a door or passageway unless door is locked or guarded.

f. Never place a ladder against a windowpane.

g. Never place a ladder against a shaky structure.

h. Make sure ladder is stable and on solid footing.

12.00 Fire Protection

12.01 CONTRACTOR and its subcontractors shall take all reasonable precautions to prevent fires.

12.02 CONTRACTOR and its subcontractors shall dispose of paper, rags, trash, and other combustible materials only in safe containers.

12.03 CONTRACTOR and its subcontractors shall transport and store flammable liquids, such as gasoline, kerosene, and fuel oil, in industry-approved metal containers designed specifically for handling these liquids. Such flammable liquids shall be stored away from possible sources of ignition in accordance with recognized industry standards or guidelines.

12.04 Portable fuel containers shall never be filled while located in the bed of a pickup truck or other vehicle The fuel container shall be placed on the ground prior to filling in order to safely dissipate any static charge that may develop during filling.

12.05 CONTRACTOR and its subcontractors shall not alter or tamper with fire protection equipment or render it inaccessible.

12.06 CONTRACTOR and its subcontractors shall not open or close hydrants or main water valves except after prior notice to the appropriate COMPANY representative or in the case of emergency.

12.07 CONTRACTOR and its subcontractors shall immediately report to designated COMPANY personnel any leak or indication of gas around piping or vessels. CONTRACTOR and its subcontractors shall assure that all "hot work" in the area ceases immediately on the discovery of the hazard.

12.08 CONTRACTOR and its subcontractors shall use for cleaning purposes only cleaning solvents that have a high flash point (above 140°F, and below 200°F) and are non-toxic unless otherwise specified by a regulatory agency.

12.09 CONTRACTOR and its subcontractors shall be responsible for the safety and fire protection training of their employees.

12.10 CONTRACTOR and its subcontractors shall provide their own fire protection equipment unless otherwise agreed with COMPANY in writing.

12.11 CONTRACTOR and its subcontractors shall shut down internal combustion engines before they are refueled, except where the refueling point is sufficiently remote from the engine to allow safe refueling.

12.12 The first priority shall be the safety of all personnel. In case of fire, CONTRACTOR and subcontractor personnel in the area shall immediately take all practical measures to protect the safety of all personnel and to extinguish the fire. CONTRACTOR or subcontractor shall notify the COMPANY representative of the fire as soon as possible.

12.13 In case of fire, CONTRACTOR and its subcontractors shall shut down all equipment and remove it from the fire location if feasible and shall clear access routes.

12.14 Motors, compressors, pumps, and other equipment are permitted inside tank dike areas only in accordance with COMPANY hot work permit procedures.

13.00 Medical Aid

13.01 The CONTRACTOR and its subcontractors shall provide its own first aid personnel, equipment, and supplies which shall meet requirements of local, state, and federal regulations unless otherwise agreed by the parties in writing.

14.00 Personal Protective Equipment

14.01 CONTRACTOR and subcontractor personnel on the job site shall wear appropriate personal protective equipment, including but not limited to, fall protection, steel-toed and shanked safety shoes, hard hats, safety glasses (with side shields) and additional personal protective equipment (e.g. FRC, hearing protection, respiratory protection, face shields, hand protection) as may be required by the nature of the work and/or as specified by regulations or the COMPANY. The required personal protective equipment shall be identified in the HES Protection work plan and the JSA for the work to be performed. CONTRACTOR and its subcontractors shall provide such equipment unless otherwise agreed by COMPANY in writing. If specialized personal protective equipment is required within CONTRACTOR's or its subcontractors specific work area, it, or its subcontractors, shall post signs specifying where personal protective equipment use is required.

14.02 All personal protective equipment shall be used and maintained by CONTRACTOR and its subcontractors in accordance with manufacturer recommendations.

14.03 CONTRACTOR shall provide fall protection rescue equipment and personnel trained in its use, if performing work that requires fall protection equipment.

15.00 Housekeeping

15.01 CONTRACTOR and its subcontractors shall maintain good housekeeping at all times and shall keep all working areas clean and free of obstructions. Tripping hazards shall be clearly identified and marked.

15.02 CONTRACTOR and its subcontractor shall keep access to emergency exits clear at all times.

16.00 Incident Reporting

16.01 CONTRACTOR and its subcontractors shall promptly and accurately report all on-the-job incidents/injuries to the proper governmental authorities, where required, and to the appropriate COMPANY representative. CONTRACTOR shall report and document all potential hazards, unsafe conditions, and unsafe acts. All near-miss reports shall be provided to the appropriate COMPANY representative.

16.02 CONTRACTOR and its subcontractors shall immediately report all incidents to COMPANY and confirm the report in writing within twenty-four(24) hours after the incident occurs. This includes fatalities, injuries, fires, releases of hazardous substances, motor vehicle accidents, and damages to COMPANY equipment.

16.03 CONTRACTOR and its subcontractors shall maintain and file required incident forms pursuant to COMPANY procedures or as required by law, decree, administrative rule or regulation, or other legally binding policy interpretation or pronouncement of a legal jurisdiction or authority.

16.04 CONTRACTOR and its subcontractors shall promptly send to the appropriate COMPANY representative copies of all governmental health, environmental or safety citations against CONTRACTOR or its subcontractors while performing the work.

16.05 CONTRACTOR and its subcontractors shall provide written summaries of all incidents affecting safety and spills to the COMPANY safety representative monthly, unless otherwise specified by COMPANY safety representative monthly, unless otherwise specified by COMPANY. CONTRACTOR shall have personnel trained to perform a Root Cause Analysis (RCA). CONTRACTOR shall commence a RCA within three(3) days after the occurrence of an incident and provide a copy to COMPANY promptly. CONTRACTOR companies shall have a formally trained person to lead a root-cause analysis (RCA) investigation. RCA is required when:

- An incident results in an OSHA recordable injury or fatality.
- A hazardous material or petroleum release spills 1 gallon or greater on land or results in a sheen on water.
- A discharge exceeds National Pollutant Discharge Elimination System (NPDES) guidelines or permits.
- A fire occurs.
- A motor vehicle crash (MVC) takes place in a COMPANY car or leased vehicle, a contractor vehicle, or in a vehicle solely assigned to COMPANY business.
- A “near miss/loss” or minor incident occurs, which, under different circumstances, would have resulted in a serious injury, reportable spill, property loss, fire, or MVC.
- An incident occurs frequently.
- A significant financial incident occurs, e.g., equipment failure.

To conduct an RCA, include at least the following six steps

1. Describe what happened, when, and where.
2. Determine the actual and potential loss or losses
3. Determine the root causes of the incident.
4. Determine the risk of recurrence.
5. Develop controls to reduce the risk of recurrence.
6. Communicate the lessons learned.

Share all RCAs completed for incidents on COMPANY property with the COMPANY Project Manager, Business Unit Manager, and OE/HES Manager within 3 days. CONTRACTORS are welcome to include COMPANY personnel on their RCA teams, as they deem appropriate. In situations where an incident involves multiple contract companies or contract and COMPANY personnel, COMPANY may put together an incident investigation team made up of personnel from all affected companies.

17.00 Environmental Protection

17.01 CONTRACTOR and its subcontractors shall prevent spills or releases of oil or chemical substances on land, water or air. Pollution prevention shall be a routine part of CONTRACTOR's and its subcontractors' business and work activities.

17.02 CONTRACTOR and its subcontractors shall exercise all necessary care to protect and preserve the environment, including flora, fauna and other natural resources or assets at any location where the work is performed. CONTRACTOR and its subcontractors shall minimize and mitigate unavoidable impacts to the local environment.

17.03 CONTRACTOR and its subcontractors shall assess the environmental hazards of materials and supplies used in conjunction with the work and shall use substitute materials presenting less risk whenever possible.

17.04 CONTRACTOR and its subcontractors shall keep a reasonable degree of order by properly disposing of accumulated rubbish and waste materials. CONTRACTOR and its subcontractors shall start site cleanup and remediation immediately upon completion of work at that site.

17.05 Unless otherwise approved by an authorized COMPANY representative, CONTRACTOR and its subcontractors shall prohibit their employees from hunting, disturbing, or capturing native birds, fish or other animals in the vicinity of the work site.

17.06 CONTRACTOR and its subcontractors shall not remove trees and vegetation to an extent greater than is necessary for the work, as determined by COMPANY or in accordance with the applicable permit. Whenever feasible, CONTRACTOR

and its subcontractors shall stockpile topsoil for subsequent use in site restoration.

17.07 CONTRACTOR and its subcontractors shall use only above-ground steel tanks that are properly grounded as fuel storage tanks. CONTRACTOR and its subcontractors shall assure that loading and drainage connections to fuel storage tanks are either plugged or locked in the closed position when not in use, and that fuel dispensing nozzles are self-closing.

17.08 All onshore, above-ground fuel, oil and chemical storage tanks used by CONTRACTOR or its subcontractors shall have secondary containment with a capacity of one hundred ten percent (110%) of the capacity of the largest single tank. Secondary containment impounds may have a drain connection for removal of storm water, provided the drain discharge is normally plugged or equipped with a valve normally locked closed. In those areas governed by Federal or State SPCC plans, CONTRACTOR is expected to comply with those requirements.

17.09 CONTRACTOR and its subcontractors shall not discharge oil, solvents, chemicals, etc. to water bodies or onto land.

17.10 CONTRACTOR and its subcontractors shall protect fossils and antiquities found at job sites from damage or disturbance. CONTRACTOR and its subcontractors shall report the location to COMPANY and cease work at that location pending further instructions.

17.11 CONTRACTOR and its subcontractors shall comply with all federal, state and local laws, rules, regulations, agency policies and guidance documents relating to pollution or protection of the public health and the environment including, but not limited to, the emission, discharge, release, manufacture, processing, distribution, use, treatment, handling, storage, disposal, or transportation of substances, materials, pollutants, contaminants, chemical, solid waste, and/or hazardous substances. Among the laws and regulations with which CONTRACTOR and its subcontractors shall comply are: The Resource Conservation Recovery Act; The Comprehensive Environmental Response, Compensation, and Liability Act; the Substances Control Act; the Emergency Planning and Community Right to Know Act of 1986; the National Environmental Policy Act; the Occupational Safety and Health Act; the Pollution Prevention Act of 1990; the Oil Pollution act of 1990; the Clean Air Act; and the Hazardous Materials Transportation act, as well as the amendments to any of the foregoing.

18.00 Miscellaneous

18.01 The use, possession, distribution, or sale of illegal drugs and controlled substances used by any person while on COMPANY premises or while engaged in performing services or while engaged in performing services for COMPANY is absolutely prohibited. However, prescription medication that is obtained by a valid prescription and that does not impair work performance is exempted from this prohibition. This prohibition also applies to the use, possession, distribution, or sale of unauthorized alcohol, firearms, and explosives. COMPANY specifically

reserves the right to carry out reasonable searches of individuals, their person, effects, and vehicles when entering, on, and leaving COMPANY premises. Individuals found in violations shall be removed from COMPANY premises immediately, and, if warranted individuals will be reported to the appropriate law enforcement agencies. Submission to such a search is strictly voluntary; however, refusal will be cause for not allowing that individual on COMPANY premises.

18.02 Compressed gas cylinders shall be secured in place on a regular cart or chained to a support in an upright position. All cylinders not in use shall be protected with protective valve caps. Compressed oxygen and flammable gases shall not be stored near combustible materials, but shall be stored in accordance with facility safety procedures and local, state, and federal regulations.

18.03 No firearms, ammunition, or deadly weapons are permitted on COMPANY property except as may be authorized by COMPANY for security purposes to ensure adequate protection of property and employees.

18.04 All CONTRACTOR safety equipment shall be properly maintained and operable in accordance with manufacturer's instructions and applicable federal, state, and local regulations.

18.05 CONTRACTOR employees shall be properly trained to handle all applicable safety equipment.

18.06 The CONTRACTOR shall ensure that their personnel abide by existing state, federal, and local occupational health and safety regulations.

18.07 The COMPANY Representative and the CONTRACTOR shall review the final/completed work site to determine that hazards related to the work site have been removed in accordance with facility requirements.

18.08 Only CONTRACTOR photographers are permitted to carry cameras or take pictures within COMPANY locations. If CONTRACTOR is required to take photographs during the performance of the Services, CONTRACTOR must obtain prior written approval from COMPANY.

19.00 Suspension of the Work

19.01 Both COMPANY, CONTRACTOR and its Subcontractors shall have the right to stop work at any time the work environment is imminently hazardous to persons, property, or the environment.

20.00 Barricades and Open Holes

20.01 CONTRACTOR and its subcontractors shall assure that all ditches, holes, excavations, overhead work, etc. shall be properly barricaded and, where necessary, provided with warning lights.

21.00 Short Service Employees (SSE)

21.01 A short service employee is an individual who has been employed by CONTRACTOR or subcontractor for less than six (6) months or has been in a like job by CONTRACTOR for less than six (6) months. SSE personnel shall be visibly identified at COMPANY worksites with a Hi-Visibility orange hard hat or at some active COMPANY sites with the COMPANY approved Visitor Color hard hat unless otherwise specified in the HES Protection Work Plan. No one person crew and on crews of 5 persons or more no more than 20% may be SSE's. CONTRACTOR shall notify COMPANY of any SSE's on its crews. A qualified mentor must be assigned to each SSE to monitor the SSE's job performance. Exceptions to the SSE policy may be made only with COMPANY's prior approval.

22.00 Safety Reports

22.01 CONTRACTOR shall complete COMPANY's designated Safety Questionnaire. A new Safety Questionnaire shall be submitted annually.

22.02 In addition to the Safety Questionnaire, within thirty (30) days after the end of each calendar quarter, CONTRACTOR shall update COMPANY's designated Safety Questionnaire with manhours worked during the preceding quarter and incidents that occurred for CONTRACTOR's overall workforce or Environmental Division workforce and CONTRACTOR's workforce that was working on COMPANY's property or work site.

23.00 Training

23.01 CONTRACTOR and its subcontractor personnel shall be fully trained in compliance with appropriate health, environmental and safety training codes, standards, laws and regulations of all governmental or regulatory agencies having jurisdiction at the work site (e.g., MMS, USCG, DOT, OSHA). CONTRACTOR and its subcontractors shall inform their employees of the training required to perform tasks and ensure that their employees shall not perform any job for which specific training is required until such training is successfully completed. All training shall be documented. Upon Company's request, Contractor and its subcontractors shall provide Company with a letter of certification that validates training requirements are met and maintained.

23.02 CONTRACTOR shall implement a Preventative Maintenance Program that identifies and prioritizes maintenance for safety-critical items as identified in the HES Protection work Plan.

23.03 COMPANY representatives shall have the right, at any time, to require CONTRACTOR and its subcontractors to remove and bar from the work site any personnel whose conduct could jeopardize the safety of any person or operation.

24.00 Drug, Alcohol and Search Policy

24.01 The COMPANY's Drug, Alcohol and Search Policy, as detailed on Form Nos. G0-279A and B, is hereby incorporated into this Contract by reference and shall be applicable to all work performed hereunder, including all subcontractors. Below is a more definitive description of Safety sensitive Positions than you will find in the attached forms:

Definition of Safety-Sensitive Positions for EMC

All on-site CONTRACTOR employees and its subcontractors at COMPANY's sites, up to and including CONTRACTOR's Program Manager, are considered Safety Sensitive positions.

25.00 Termination and Warnings

25.01 In the event of violation or breach of these guidelines, COMPANY shall have the right to terminate any and all agreements related to the job and hold the CONTRACTOR liable for any and all damages resulting therefrom. COMPANY shall attempt to give CONTRACTOR notice of the violation or breach and allow CONTRACTOR a reasonable time as stated in the notice to correct or remedy the violation or breach depending on the nature and seriousness of the violation or breach.

THIS PAGE ENDS THE INDEPENDENT CONTRACTOR HEALTH, ENVIRONMENTAL AND SAFETY GUIDELINES

ATTACHMENT D

DRUG, ALCOHOL, AND SEARCH POLICY
GENERAL REQUIREMENTS

ATTACHMENT D

DRUG, ALCOHOL, AND SEARCH POLICY
GENERAL REQUIREMENTS

SUBCONTRACTOR and its sub-subcontractors shall comply with COMPANY's Drug, Alcohol, and Search Policy as described in NOTICE TO SUBCONTRACTOR EMPLOYEES (GO-279B).

In furtherance thereof, SUBCONTRACTOR and its sub-subcontractors shall be subject to the following terms and conditions:

1. SUBCONTRACTOR shall provide a copy of NOTICE TO SUBCONTRACTOR EMPLOYEES (GO-279B) to all of its employees and advise them of the COMPANY'S right to search prior to assigning them to work under this contract.

2. SUBCONTRACTOR shall have in place controlled substance and alcohol policies that meet or exceed the requirements specified in MINIMUM SUBCONTRACTOR CONTROLLED SUBSTANCE AND ALCOHOL PROGRAM REQUIREMENTS (GO-279C). Nothing in this EXHIBIT shall be construed to require CONTRACTS to violate any Federal, State or local laws, ordinances or regulations.

3. Pursuant to such policies SUBCONTRACTOR shall perform or have performed a controlled substance test on each of its employees to be assigned to work under this contract in safety-sensitive positions as defined in MINIMUM SUBCONTRACTOR CONTROLLED SUBSTANCE AND ALCOHOL PROGRAM REQUIREMENTS (GO-279C) before such employee is so assigned. SUBCONTRACTOR shall not assign any individual to perform any services under this contract who has tested positive for controlled substances or alcohol within six (6) months prior to such assignment without COMPANY's consent in writing. COMPANY shall have the right to withhold such consent in its sole discretion.

4. COMPANY shall have the right to request that SUBCONTRACTOR perform or have performed a controlled substance and/or alcohol test on any of SUBCONTRACTOR's or its sub-subcontractors employees while on COMPANY premises, engaged in COMPANY business or operating COMPANY equipment, whereupon SUBCONTRACTOR shall immediately suspend services of such individual under the contract and remove such individual from COMPANY premises. Such individual shall not be returned to perform services under the contract until SUBCONTRACTOR has requested reinstatement and received COMPANY'S consent to reinstate such individual. Such request for reinstatement shall be in writing signed by SUBCONTRACTOR's authorized representative and shall include if applicable;

    (a) a certification by SUBCONTRACTOR that the individual tested negative on the requested test for controlled substances and/or alcohol and the date and time that the specimen was collected.

(b) if such individual was not tested for controlled substances or alcohol an explanation of the reasons,

(c) a certification by SUBCONTRACTOR that the individual is participating in or has completed a rehabilitation program for substance abuse, and

(d) any additional information SUBCONTRACTOR wishes COMPANY to consider. COMPANY shall reimburse SUBCONTRACTOR for direct, actual out-of-pocket expenses for such tests requested by COMPANY to be performed on specific employees, however COMPANY shall not reimburse SUBCONTRACTOR for lost time for an individual who tests positive or refuses, delays, or fails to have a requested test or for time spent in rehabilitation programs and the like. All such expenses shall be evidenced by documentation satisfactory to COMPANY.

COMPANY shall have the sole discretion to determine whether the individual will be reinstated to perform services under the contract.

5. SUBCONTRACTOR shall not assign any individual who has been in violation of COMPANY's drug and alcohol testing requirements by refusing or failing to complete a requested test or by testing positive for drugs and/or alcohol, to perform services under any contract with COMPANY or its affiliated companies until SUBCONTRACTOR has first notified the Facility contract office that the employee had been previously disqualified from performing services for COMPANY or its affiliated companies for violation of drug or alcohol policies and whether the employee has participated in or completed a substance abuse rehabilitation program. COMPANY shall have the right to exclude such individual from performing services under and such contract in its sole discretion.

6. SUBCONTRACTOR shall keep books and records of all of its activities in compliance with the terms of this Exhibit and shall maintain such books and records for a period of at least twenty-four (24) months after termination of this contract. COMPANY or its representatives shall have the right to audit such books and records in the same manner provided for other books and records under the Records and Audits provisions of this contract; provided however, that COMPANY or its representative shall not have access to individual controlled substance or alcohol test results where such access is prohibited by applicable law.

7. Ninety (90) days after execution of this contract and on that date every year thereafter, SUBCONTRACTOR shall provide COMPANY with a written report of its activities under this Exhibit. Such report shall state;

   (a) The number of pre-work tests performed,

   (b) The number of other tests performed,

   (c) The number of positive test results,

   (d) The number of individuals who declined to be tested, and

   (e) The number of individuals who were removed from service under the Exhibit.

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8. If SUBCONTRACTOR or its sub-subcontractors fail to comply with the provisions of the Exhibit, COMPANY shall have the right to terminate this contract for material breach.

OPTIONAL CLAUSES

The following optional clauses operate to implement the program guidelines for random testing and alcohol testing. By checking the appropriate box(es) select A, B, or C. If alcohol testing is required, select D also. If a box is checked, the provisions of that program element are incorporated as a part of these requirements.

☒ **A. Random Testing, Safety Sensitive Positions**

Where legally permissible, SUBCONTRACTOR and its subcontractors shall conduct unannounced random testing for controlled substances [and alcohol] of employees in safety-sensitive positions.

Such testing shall be performed pursuant to a random selection method with a minimum annual testing rate of fifty percent of the total population working under the contract in safety-sensitive positions. Employees testing positive or failing to participate in the requested testing shall be subject to the provision of Sections 4 and 5.

☐ **B. Universal Random Testing**

Where legally permissible, SUBCONTRACTOR and its sub-subcontractors shall conduct unannounced random testing for controlled substances [and alcohol] of all employees performing services under the contract. Such testing shall be performed pursuant to a random selection method with a minimum annual testing rate of fifty percent of the total population working under the contract. Employees testing positive or failing to participate in the requested testing shall be subject to the provisions of Sections 4 and 5.

☐ **C. Universal Pre-Work Testing**

Where legally permissible, SUBCONTRACTOR and its sub-subcontractors shall conduct a test for controlled substances [and alcohol] of all employees prior to their performance of services under the contract. Only employees testing negative with no positive test any time within a six-month period prior to starting work shall be assigned to perform services under the contract.

☐ **D. Alcohol Testing**

Where legally permissible, SUBCONTRACTOR and its sub-subcontractors shall have established the right to perform and capability of performing alcohol testing of breath or blood specimens of its employees upon request of COMPANY. The cut-off level for a positive alcohol test shall be a blood alcohol concentration of no more than 0.04 percent

(%BAC). Employees testing positive or failing to participate in a requested test will be subject to the provisions of Sections 4 and 5.

DRUG, ALCOHOL, AND SEARCH POLICY
NOTICE TO SUBCONTRACTOR EMPLOYEES

Policy

The Policy of COMPANY and its affiliated companies regarding illegal drugs and controlled substances, alcoholic beverages, and firearms is:

1. The use, possession, distribution, purchase or sale of any illegal drugs or other controlled substances by any person while on COMPANY premises, engaged in COMPANY business or while operating COMPANY business or while operating COMPANY equipment is prohibited.

2. The use of any illegal drug or other controlled substance or alcohol which causes or contributes to unacceptable job performance or unusual job behavior is prohibited. Being under the influence of alcohol while on COMPANY premises, engaged in COMPANY business or while operating COMPANY equipment is prohibited.

3. The use, possession, transportation, or sale of explosives, unauthorized flammable materials, firearms, or other weapons by SUBCONTRACTOR, its sub-subcontractors or their employees while on COMPANY premises, engaged in COMPANY business or while operating COMPANY equipment is prohibited.

4. The unauthorized use, possession, transportation, or sale of alcoholic beverages by SUBCONTRACTOR, its sub-subcontractors or their employees while on COMPANY premises or while operating COMPANY equipment is prohibited.

SUBCONTRACTOR's and sub-subcontractors' employees shall abide by this Policy. Any person violating this Policy shall be removed from Company premises and may be denied future access to premises of COMPANY and its affiliated companies. In addition, COMPANY may suspend work or, in repeated or serious situations, terminate a contract as a result of violation of this Policy. In appropriate cases, local law enforcement agencies may be advised of violations.

In support of this Policy, COMPANY may conduct or require searches and require test as set forth in the following:

Search

Unless prohibited by applicable law, without prior announcement, and at any time, COMPANY may carry out reasonable searches of individuals and their personal effects when entering COMPANY premises, while on COMPANY premises, and when leaving COMPANY premises,

and COMPANY may require SUBCONTRACTOR to search its employees or sub-subcontractor's employees before entering COMPANY premises, engaging in COMPANY business or operating COMPANY equipment. Entry onto COMPANY premises constitutes consent to a search of the person and his/her personal effects, including, without limitation, packages, briefcases, purses, lunch boxes and vehicle, or any office, locker, closet or desk. An individual may elect to decline to cooperate; however, refusal to cooperate shall be cause for not allowing that individual on premises of COMPANY or its affiliated companies.

Testing

Unless prohibited by applicable law, COMPANY may request SUBCONTRACTOR to conduct a controlled substance and/or alcohol test(s) on any of its employees or sub-subcontractors' employees while on COMPANY prernises, engaged in COMPANY business, or operating COMPANY equipment. In addition, COMPANY may request SUBCONTRACTOR to conduct a controlled substance and/or alcohol test(s) on any of its employees or sub-subcontractors' employees before entering COMPANY premises, engaging in COMPANY business, or operating COMPANY equipment. Prior written consent shall be obtained from any person who is to be tested. A positive test on a SUBCONTRACTOR or sub-subcontractor employee or failure to give written consent for a test shall be cause for removal from COMPANY premises and shall result in the SUBCONTRACTOR or sub-subcontractor employee being restricted or disqualified from performing services for COMPANY or its affiliated companies.

Notification of search and/or testing by CONTRACTOR

Prior to conducting a search and/or testing of its or subcontractors' employees on COMPANY premises, SUBCONTRACTOR shall notify the local COMPANY facility manager.

Definitions

As used herein, "controlled substance" specifically includes opiates, including heroin, hallucinogens, including marijuana, mescaline, and peyote; cocaine; PCP; and prescription drugs, including amphetamines and barbiturates, which are not obtained and used under a prescription lawfully issued to the person possessing them or which are not authorized by the COMPANY Medical Staff; and any other substance included in the Federal Controlled Substances Act or its regulations or unlawful under applicable law.

As used herein, controlled substance or alcohol "test" means any test using blood, urine, breath or other samples to determine the presence of controlled substances or alcohol in the body.

As used herein, "COMPANY premises" is used in the broadest sense, and includes, but is not limited to, all land, property, buildings, structures, installations, COMPANY operated service stations (but not COMPANY owned stations operated by independent dealers), vehicles, equipment, aircraft, and water craft owned, leased, or in any other manner being used by COMPANY for any purpose.

As under herein, "under the influence of alcohol" is defined as having a blood alcohol concentration (%BAC) of 0.04% or above.

ATTACHMENT E

DRUG, ALCOHOL, AND SEARCH POLICY – MINIMUM CONTRACTOR CONTROLLED SUBSTANCE AND ALCOHOL PROGRAM REQUIREMENTS

ATTACHMENT E

DRUG, ALCOHOL, AND SEARCH POLICY
MINIMUM SUBCONTRACTOR CONTROLLED SUBSTANCE AND ALCOHOL PROGRAM REQUIREMENTS

Policy

Unless prohibited by applicable law, SUBCONTRACTORS and their sub-subcontractors are required to have a written drug and alcohol policy and implementation program that meet the minimum requirements below.

Training

SUBCONTRACTORS' employees shall receive communication and training on at least the following topics:

1. COMPANY'S and SUBCONTRACTORS' drug and alcohol policies.

2. The effects and consequences of controlled substance use on personal health, safety, and work environment.

3. The details of SUBCONTRACTORS' employee assistance program, if any, and available treatment resources.

4. The consequences to SUBCONTRACTORS' employees for failing to comply with CONTRACTOR'S and COMPANY'S policies.

In addition, SUBCONTRACTOR's supervisors shall receive training on the manifestations and behavioral causes that may indicate controlled substance use or abuse. SUBSUBCONTRACTORS shall develop and conduct its own training programs for all of its supervisors and employees on at least a biannual basis.

Employee Assistance

COMPANY encourages SUBSUBCONTRACTORS to make Employee Assistance Programs (EAP) and rehabilitation for chemical dependency available to its employees.

Search

SUBCONTRACTORS shall have the right to perform reasonable unannounced searches of its employees, including personal vehicles and personal effects, while on COMPANY property. Prior to conducting a search and / or test of its or sub-SUBCONTRACTORS' employees on COMPANY premises, SUBCONTRACTORS shall notify the local COMPANY facility manager.

Pre-Work Testing

SUBCONTRACTORS shall conduct a pre-work drug test on their employees prior to starting work in a COMPANY facility in a position in which the employee performing the duties of the position has the ability to create hazards or danger to other individuals, the community, or the environment ("safety sensitive position"). A negative test and no positive tests any time within a six-month period prior to starting work is acceptable. Pre-work testing shall not be required for individuals already working in a COMPANY facility at the time this contract provision becomes effective.

For-Cause Testing

SUBCONTRACTORS shall have the right to perform controlled substance and alcohol tests based on a reasonable belief by SUBCONTRACTORS or COMPANY that an individual is using alcohol or drugs on the basis of specific physical, behavioral, or performance indicators.

SUBCONTRACTORS shall have the right to remove any employee from performing work if the individual exhibits unusual job behavior or unacceptable job performance and it is believed by SUBCONTRACTORS or COMPANY that he/she may be using controlled substances or presently under the influence of alcohol.

Post-Accident Testing

SUBCONTRACTORS should conduct an immediate preliminary evaluation into the circumstances of all accidents, injuries, and mishaps. This evaluation shall include a review of the conduct and behavior of appropriate individuals following any unexplainable incident or near-miss involving such individuals to determine whether those incidents could have been caused or contributed to by drug or alcohol abuse by such individuals. Whether an injury or illness occurs as a result of the incident is not the controlling factor. When that evaluation reveals reasonable cause, alcohol and/or drug test(s) shall be requested by CONTRACTOR.

Post-accident testing should be considered for the following circumstances when the preliminary evaluation indicates appropriate procedures, precautions, work set-up, or judgement were not employed.

1. Serious incident causing injury to self and/or other person.

2. Motor vehicle accident, whether or not there was significant damage to personal or private property.

3. Significant release, which fouls the environment (air, land, or water).

4. Any serious near-miss incident that could have caused injury to persons or the environment.

MINIMUM TESTING REQUIREMENTS

Controlled Substance Tests

As a minimum, the controlled substance tests conducted under the SUBCONTRACTOR's policies shall be capable of detecting the following classes of drugs: amphetamines, cannabinoids, cocaine, opiates, and phencyclidine. The SUBCONTRACTORS shall use as a guideline the Department of Health and Human Services, Guidelines for Federal Workplace Drug Testing Programs (53FR11970). These guidelines cover specimen collection procedures, chain-of-custody procedures, laboratory qualifications, testing methods and cut-off levels.

All positive tests shall be confirmed by a second test using gas chromatography/mass spectrometry (GC/MS). SUBCONTRACTORS shall use only laboratories certified by the National Institute of Drug Abuse (NIDA).

The cut off levels for the SUBCONTRACTOR's drug testing program shall be no greater than those recommended by NIDA, which are listed below:

Drug	Screen ng/ml	Confirm ng/ml
Marijuana	100	15
Cocaine	300	150
Opiates	30	300
Amphetamines	1,000	500
Phencyclidine	25	25

SUBCONTRACTORS may utilize on-site testing techniques as a preliminary indication of possible drug use, provided that individuals testing positive thereunder have the option of providing a urine specimen for testing as provided above. A positive result on an on-site test shall be treated as a positive test result unless subsequent confirmation testing is negative for controlled substances.

OPTIONAL REQUIREMENTS

Refer to the optional clauses that were selected (if any) in the Exhibit – Drug, Alcohol, and Search Policy – General Requirements (GO-279A). Indicate the applicable optional requirements by checking the appropriate box(es).

☒ **A. Random Testing, Safety Sensitive Positions**

SUBCONTRACTORS shall have the right to conduct unannounced random testing for controlled substances [and alcohol] of employees in safety-sensitive positions.

☐ **B. Universal Random Testing**

SUBCONTRACTORS shall have the right to conduct unannounced random testing for controlled substances [and alcohol] of all employees performing services under the contract.

☐ C. Universal Pre-Work Testing

SUBCONTRACTORS shall conduct a pre-work drug test on their employees prior to starting work in a COMPANY facility. A negative test and no positive test any time within a six-month period prior to starting work is acceptable. Pre-work testing shall not be required for individuals already working in a COMPANY facility at the time this provision becomes effective.

☐ D. Alcohol Testing

SUBCONTRACTORS shall have the right to perform alcohol testing of its employees upon request of COMPANY. The cut-off level for a positive alcohol test shall be a blood alcohol concentration of no more than 0.04 percent (%BAC).

ATTACHMENT F

MINIMUM RECORD KEEPING REQUIREMENTS
CONTRACT SERVICES

ATTACHMENT F

MINIMUM RECORD KEEPING REQUIREMENTS
CONTRACT SERVICES

A. INVOICE REQUIREMENTS

All *cost reimbursable, time & material or unit price* invoices submitted for payment should provide the following information. Where applicable, the invoice should reference daily work tickets by number and be supported by the subcontractor's copy.

1. Brief description, date, and location of work performed.
2. Total units (hours, days, etc.), unit rate, and *if applicable*, extended amount for each labor classification used.
3. Description of type and size, number of units, rates, and extended amount for each type or size of equipment used.
4. Quantity and description of materials furnished, unit prices, and extended amounts.
5. If more than one job is shown on an invoice, each job should be separately detailed and totaled.
6. All third party charges (*i.e. travel expenses,* subcontractors, rentals, purchases) passed through to ChevronTexaco should be supported by a copy of the *approved* invoice.

Lump sum invoices submitted for payment should provide the following information:

1. Brief description, date, location of work performed, total contract value, and percentage of work complete.

B. WORK TICKET REQUIREMENTS (*craft labor and construction activities*)

Subcontractor's supervisor or *designee* on the job should complete and sign work *tickets detailed on a daily basis, or if information is electronically input perform online review and submit* to the ChevronTexaco representative responsible for the job for review and signature. Work tickets are to be individually numbered with non-recurring numbers for ease of matching to invoices. Work tickets should provide the following information:

1. Brief description of work performed including a description of unusual conditions affecting work completion.
2. Name, classification and hours worked for each subcontractor's employee *detailed on a daily basis.*
3. Name of facility on which work was performed.
4. Size and type of equipment used and equipment identification number including hours used.
5. Quantity and description of materials furnished.
6. Arrival and departure time on location.
7. Material and quantity, equipment, or services furnished by a third party.

C. INTERNAL ACCOUNTING RECORDS

1. All labor charges should be documented by the following:
   - Payroll register listing payroll expenses for subcontractor employees working at CheveronTexaco and other companies.
   - Payment to employees in the form of a check *or electronic transfer (direct deposit)*.
   - Evidence of payment of all payroll taxes, unemployment insurance, etc.

2. Material charges should be supported in the following manner:
   - Evidence of cost or valuation of all material charged to ChevronTexaco on a cost-plus basis.
   - Evidence of payment by the subcontractor of all third party invoices charged in whole or in part to ChevronTexaco.

3. The following records should be maintained as support for equipment charges:
   - Detailed list of all equipment owned and/or used by the subcontractor (evidence of ownership where applicable).
   - Log of all equipment use (where, when, by whom).
   - Evidence of payment by the subcontractor (third party-subleased to ChevronTexaco) of all rented equipment charged to ChevronTexaco.

4. All subcontractors' charges included in billings by the subcontractor to ChevronTexaco should be supported by a paid invoice from the subcontractor, a copy of the contract between subcontractor and subcontractor, and documentation for labor, materials and equipment charges as outlined above.

5. A description of entertainment expenses (i.e., lunches, outings, event tickets, etc.) should include the following:
   - Individuals of involved and company affiliation.
   - The total cost.
   - Business purpose.

6. Records of any gifts given *of $50 or more* should include:
   - Name and company affiliation of individual receiving the gift.
   - A description of cost.
   - Business purpose.

ATTACHMENT G

SCHEDULE OF COMPENSATION

ATTACHMENT G

SCHEDULE OF COMPENSATION

SUBCONTRACTOR's compensation shall be in accordance with this Exhibit. Compensation shall be the sum of the applicable items listed below:

1. LABOR

1.1 The actual manhours expended by SUBCONTRACTOR's direct hire labor multiplied by the "Billing Rates" set forth in this Work Order. Labor as referred to herein shall mean only the labor directly employed in the performance of the Work. "Billing Rates" include all costs to SUBCONTRACTOR for base wages and for all benefits to be paid to or on behalf of the labor, and all costs to SUBCONTRACTOR not specifically provided for elsewhere in this Exhibit. Such costs include but are not limited to:

a. Reimbursement for the actual payments of any and all taxes, contributions or assessments for unemployment insurance, old age benefits, and all other payments required by law which are measured by or based upon said wages, including contributions or assessments for Workers' Compensation and premiums for Workers' Compensation Insurance;

b. Reimbursement for the actual payments for health and welfare, pension, vacation, holiday, training, transportation, subsistence and other funds which SUBCONTRACTOR is required to pay in accordance with governmental regulations or union contracts with unions having jurisdiction in the specific area of the work hereunder;

c. All charges for support personnel of any classification not listed in this Work Order and those not engaged in providing specific project deliverables, including but not limited to home office employees engaged in general administrative work such as telephone operators, janitors, guards, keypunch or data entry personnel, computer operators, reproduction staff, stenographers, secretaries, clerks, accounting (including invoice preparation) and other office services personnel.

d. All charges for office supplies and equipment, drafting paper, drafting and model supplies, computer supplies, engineering equipment, local and long distance telephone, cell phone, facsimile service, routine photocopies, and all postage and costs of routine and express or expedited document transmittal.

e. The cost for all of SUBCONTRACTOR's computer usage without limitation, including but not limited to work stations, networks, printers,

scanners, plotters, internet access and personal computers, for all job functions including but not limited to accounting, payroll, cost reporting, progress reporting, scheduling, data transmission, networks and specialized IT personnel, except as provided in item 1.3 of this Exhibit.

f. The cost of premiums for the insurance and endorsements specified in Section 11 of the Agreement and any other insurance which SUBCONTRACTOR considers necessary.

g. All charges for physical damage insurance, utilities, maintenance and repair at SUBCONTRACTOR's offices, and office space and facilities for all of SUBCONTRACTOR's employees.

h. The costs incurred by SUBCONTRACTOR related to TRIHYDRO/OWNER's representatives in SUBCONTRACTOR's office for clerical, stenographic and secretarial services, routine, day-to-day reproduction of miscellaneous documents, local telephone, postage, cost of routine document transmittal and reproduction, telegraphic and local facsimile service, office space, furniture, utilities, office supplies, and other similar support services.

i. Photo-reproduction, sales, and all other expenses incurred in preparing SUBCONTRACTOR's proposals or general sales effort.

j. The cost of recruiting and training SUBCONTRACTOR's employees, including but not limited to training for developing and maintaining SUBCONTRACTOR's health and safety program, training for TRIHYDRO/OWNER's safety program, project management processes, and other process improvement efforts, TRIHYDRO/OWNER's sharing Forum, CPEDEP Training, Management Meetings (see Process Improvement section for additional description), provided that training time shall be limited to no more than two weeks per person. Provided, however, that application to and use of tools and processes during performance of the Work is reimbursable according to the terms of item 2.8 of the Agreement.

k. The costs of performing incident investigations or root cause analysis of incidents.

l. Costs for small tools and equipment which are required for the proper performance of the Work, whether owned by SUBCONTRACTOR or rented from others and including all costs for maintenance and repair of such small tools and equipment. Small tools and equipment are defined as those that have an initial purchase price of $2,500 (Two Thousand Five Hundred Dollars) or less when new, exclusive of the cost of accessories, spare parts, operating parts, freight, taxes and handling. SUBCONTRACTOR shall furnish and maintain in good operating condition all small tools and equipment including all accessories and

spare parts therefore that are required for the performance of the Work, whether owned by SUBCONTRACTOR or rented from others.

m. The costs for routine miscellaneous materials and consumable supplies which are required for the proper performance of the Work. The types of items that are classed as "supplies," whether incorporated into the finished Work or consumed during the course of the Work. Except as provided elsewhere in this Agreement, SUBCONTRACTOR shall furnish all supplies required for the performance of the Work.

e. The cost for summarizing and reporting business statistics, volume discounts, invoice timeliness, metrics and similar items.

f. The cost of participating in joint development of process improvements and deployment of all process improvements within the SUBCONTRACTOR's organization.

1.2 It is contemplated that all SERVICES to be performed hereunder shall be performed on "straight time", in accordance with the terms of employment of SUBCONTRACTOR's personnel. SUBCONTRACTOR shall be permitted to perform overtime work at their discretion as long as charges for such work is passed on to TRIHYDRO/OWNER at standard time rates. In the event TRIHYDRO/OWNER requests, and SUBCONTRACTOR agrees to undertake, SERVICES which require shift working or working overtime, TRIHYDRO/OWNER's Authorization will state the overtime program to be worked.

1.3 The amount approved in writing by TRIHYDRO/OWNER for SUBCONTRACTOR's use of specialized IT personnel, only to the extent necessary for performance of authorized Work.

1.4 The rates shown are for SUBCONTRACTOR employees working in SUBCONTRACTOR's office. For SUBCONTRACTOR employees assigned to offices provided by TRIHYDRO/OWNER, and furnished with supplies and equipment such as computer and telephone, for a period greater than two months, the rates shown shall be reduced by twenty percent (20%).

2. MATERIAL

2.1 The actual net costs (i.e., including any applicable discounts supported by Vendor's invoices and receipted bills) to SUBCONTRACTOR for materials provided by SUBCONTRACTOR, other than consumable materials and supplies, which are covered in 1.1 (m) above.

2.2 All sales tax applicable to the actual net costs as defined in 2.1 above, and any transportation and/or cancellation penalties on alternate material already ordered

3. THIRD PARTY-OWNED EQUIPMENT

3.1 The actual net rental cost (i.e., **actual rental cost excluding sales tax**) to SUBCONTRACTOR for equipment rented from others, as supported by rental invoices and receipted bills and does not include small tools, which are covered in 1.1(l) above.

3.2 The actual net costs to cover SUBCONTRACTOR's overhead associated with rental of equipment from others. This includes the costs to procure by (project) personnel, the costs for maintenance and repair (both on and off the job site), taxes, fuel, lubricants, supplies and for insurance to cover the cost of losses or physical damage to such equipment not previously included in the rental cost.

3.3 All sales tax applicable to the actual net costs as defined in 3.1 above, and any transportation and/or cancellation penalties on alternate material already ordered.

4. SUBCONTRACTS

4.1 SUBCONTRACTOR's costs incurred for preparing bid package requests, soliciting and evaluating bids for TRIHYDRO/OWNER's large-scale one-time projects, are reimbursable in accordance with this Work Order.

4.2 (a) The actual lump sum price paid by SUBCONTRACTOR to sub-SUBCONTRACTOR for performance of work by sub-SUBCONTRACTOR, or if no such lump sum price is paid,

(b) The actual costs to sub-SUBCONTRACTOR(s) actually performing the work, including purchasing materials, as determined in accordance with 1 through 3 hereof, except that sub-SUBCONTRACTOR shall be substituted for SUBCONTRACTOR; plus the actual net rental costs (i.e., **actual rental cost excluding sales tax**) charged by equipment supplier (s) furnishing construction equipment.

4.3 Five percent (5%) of 4.2 above to cover all items of SUBCONTRACTOR's and intermediate sub-SUBCONTRACTORs' overhead and profit associated with administration of contracts and supervision of sub-SUBCONTRACTOR's, including, without limitation, order processing, invoice processing, insurance costs, financing costs, scheduling and delays.

5. SUBCONTRACTOR-OWNED EQUIPMENT

5.1 The aggregate amount determined in accordance with the Owner's Contract does not include small tools, which are covered in 1.1(l) above. The equipment billing rates include costs for maintenance and repairs (both on and off the job site), taxes, fuel, lubricants, supplies and the cost of losses or physical damage insurance for such equipment.

6. TRAVEL

6.1 The travel time of the personnel involved on the basis set forth above to the extent that such travel occurs during SUBCONTRACTOR's normal work week, for travel of personnel covered in Section 1 above and as approved with TRIHYDRO/OWNER's prior written approval. Travel time includes SUBCONTRACTOR's normal working hours, not to exceed 8 hours per day when traveling and excludes daily commuting time to jobsite.

6.2 TRIHYDRO/OWNER shall reimburse SUBCONTRACTOR for the actual costs of transportation (at coach class fares, discounted when travel planning permits), plus reasonable and appropriate actual expenses as supported by receipted bills incurred by such personnel on account of such travel, provided TRIHYDRO/OWNER's Authorization authorizes such travel.

6.3 Mileage reimbursement for SUBCONTRACTOR's employees' use of personal cars shall not exceed the IRS accepted rate for tax purposes.

7. OTHER ITEMS

7.1 The actual cost of providing, maintaining, and removing the Field Construction, Remediation, or Treating Office Building(s) at the site, including but not limited to the cost of office equipment and computers of all types and software therefore; reproduction costs, supplies, stationary; postage; local and long distance telephone service; facsimile service; heating, cooling, and lighting; sanitary facilities for office employees; first aid facilities for all employees; drinking water, and all utilities, except any utilities furnished by TRIHYDRO/OWNER; and similar costs incidental to the operation of said Field Construction, Remediation, or Treating Office Building(s).

7.2 The actual cost of providing any buildings (other than the Field Construction, Remediation, or Treating Office), as approved by TRIHYDRO/OWNER, for temporary construction, remediation, or treating needs such as warehouses, tool rooms, welding sheds and change rooms (by construction or rental), or other facilities which are necessary for protection of materials, equipment, and/or Field Craft Labor, or as may be required by written union agreements; the cost of utilities for use on the site in the construction, remediation, or treating Work; the cost of utility lines; the cost of sanitary facilities for Field Craft Labor, and the cost of dismantling and removing any

portion of such temporary facilities from the site as may be directed by TRIHYDRO/OWNER.

7.3 The actual cost of testing the completed Facility or parts thereof, if necessary, including the cost of providing vendor services for startup.

7.4 The actual cost for bonds required by law or by TRIHYDRO/OWNER and applicable only to the Work hereunder.

7.5 The actual costs for reproduction of non routine specific project deliverables, which may include agency submittals, bid specifications and packages

8. PERMITS

8.1 The actual cost of any permits, fees, licenses or deposits necessitated by applicable statutes or by law, and required by SUBCONTRACTOR for the prosecution of its business and which are or would be applicable to work performed by SUBCONTRACTOR for others as well as to the Work hereunder.

8.2 The actual cost of licenses, permits, testing and inspection fees required for and applicable only to the Work hereunder.

THIS PAGE ENDS SCHEDULE OF COMPENSATION

ATTACHMENT H

RATE SHEET

CENTECH, INC.

920 Lakeview Lane, Casper, Wyoming 82604 (307) 265-7621

Friday, October 8, 2004

Trihydro / Chevron Texaco Refining Co.
Casper Wy.
Att: Shaun Harshman # 307-237-7460

Bid: Casper Refinery / (Heavy Crude Bottoms) 2,000+ BBLS

Price:	$ 7.50	Per BBL
Minimum:	$ 1,650.00	Per Day covers daily transportation to and from location, expenses & insurance
Mobilization:	$ 000.00	Trucking of mobile unit, De-con trailer and Generator will be charged to and from location.
Support Equipment:	$ 0000.00	Per Mo Portable Power (300 KW)
	$ 0000.00	Per Mo Front Loader
Prices Include:		Complete mobile unit, Man power and Support equipment
Power Required:		3 Phase 480/440 (400 Amp Service) Portable Power 250 KW (minimum)
Conditions:		Customer will handle all solids, produced water and sale of oil. Customer will also provide tanks, pits or other means to handle volume of discharged oil and water from Centrifuge Unit.

All prices and operations based on daylight hours

CENTECH, INC.
Sincerely,

Neal Miller
Pres

Maurice M. Casad
M&S Supervisor
Rocky Mountain Business Unit
Northern Rockies Businesses

Conoco Inc.
401 S. 23rd Street
Billings, MT 59101
(406) 255-2515

March 4, 1998

Centech, Inc.
920 Lakeview Lane
Casper, WY 82604

Attention: Mr. Neal Miller

Subject: Centech, Inc. Services Proposal
Letter of Authorization under Breo 98-624

Conoco Inc. ("Company") accepts the Centech, Inc. ("Contractor") proposal of Feb. 2, 1998 ("Proposal") for the estimated amount of US $300,000 plus materials, and equipment if needed. Work to be preformed is a three phase centrifuge separation process of 15,000+ barrels of heavy crude tank bottoms. This work is to be done under the terms and conditions of the Services Contract BREO-98-624 between Company and Contractor and in accordance with Contractor's Proposal. It is agreed that Contractor will, as an independent Contractor, provide the agreed services on a time and materials cost plus basis in accordance with the Proposal.

The scheduling of the work and handling of time and material sheets and invoices must be coordinated with Dave Floyd, Conoco Inc., (406) 255-2678.

Please indicate your agreement to the foregoing by signing below in the space provided and returning one copy to Maurice Casad, Conoco Inc., 401 S. 23rd Street, Billings, Montana 59101.

Regards,

Maurice Casad

Maurice Casad

Accepted and Agreed:

Centech, Inc.

By: Neal Miller

Title: Pres

Date: 5-5-98

cc: MMC file, D. Floyd

conoco

Brenda Huschka
Materials & Services
Rockies Business Unit

Conoco Inc.
401 South 23rd Street
Billings, MT 59101
(406) 255-7970

March 4, 1998

Centech, Inc.
Attn: Neal Miller
920 Lakeview Lane
Casper, WY 82604

Subject: Contract # BREO 98-624 Pipeline Maintenance

Dear Mr. Miller:

Enclosed please find two contracts for this work. Please sign and return both contracts to the undersigned, and an original executed contract will be returned to you for your files.

Also included is a standardized Pre-Qualification Form (PQF) and a Pipeline and Terminal Safety Guide. Please fill out and return the PQF form. The Safety Guide is for your use.

You will need to have in place a Department of Transportation Drug and Alcohol Plan that meets DOT 49 CFR 199 for doing maintenance work on the Pipe Line. **Please forward your plan to the address listed below.** If you do not currently have a plan, you can call or write to the following address to receive the proper paperwork that needs to be completed, returned to the below address and approved for the Department of Transportation Drug and Alcohol Plan:

National Compliance Management Service, Inc.
Attn: Richard Rippert, Vice President
7 Compound Drive
Hutchinson, Kansas 67502
(316) 669-0954 Ext. 410
Fax: (316) 669-8430

If you have any questions, please contact the undersigned at (406) 255-7970. Thanks for your attention to this matter.

Regards,

Brenda Huschka

Brenda Huschka

cc: MMC file

Maurice M. Casad
M&S Advisor- Contracts
Rockies Business Unit

Conoco Inc.
401 South 23rd Street
Billings, MT 59101
(406) 255-2515

March 30, 1998

Centech, Inc.
Attn: Neal Miller
920 Lakeview Drive
Casper, WY 82604

Subject: Contract # BREO-98-624

Enclosed please find an original executed contract for the above work for your files.

If you have any questions, please give me a call. Thank you for your assistance.

Regards,

Maurice Casad

Maurice Casad

cc: MMC file

other legal remedies. From compensation payable to Contractor, Company may deduct the amount necessary to discharge such liens or claims and may recover all related costs, including administrative costs, legal fees and expenses.

4.0 TERM

The term of this Contract shall be from the Effective Date of March 20, 1998 to March 20, 2000.

5.0 CONTRACTOR REGISTRATION NUMBERS

Contractor shall be registered as an employer under applicable laws. Contractor's registration numbers are:

Federal 45-0397962 State ____________________ Local ______________

6.0 NOTICES

Notices or demands required or permitted under this Contract shall be sent by certified U.S. mail (postage paid, return receipt requested), courier, or facsimile transmission properly addressed as follows:

	Company	Contractor
Company Name:	Conoco Inc.	Centech, Inc.
Address:	2301 5th Ave. South	920 Lakeview Drive
	PO Box 30198 59107-0198	Casper, Wy 82604
	Billings, MT 59101	
Title of Contact Person:	Maurice Casad	Neal Miller
Telephone No.:	406-255-2515	307-265-7621 office/fax
Fax No.:	406-255-2621	307-473-8040 shop

Notices shall be effective when received by the addressee.

The parties have executed this Contract through their authorized officers or representatives.

CONOCO INC.	CONTRACTOR
BY: Maurice Casad	BY: Neal Miller
PRINTED NAME: MAURICE CASAD	PRINTED NAME: Neal Miller
TITLE: M&S SUPERVISOR	TITLE: Pres.

Services and Drilling Master Contract

Unocal North American Oil & Gas Division
Unocal Geothermal Division

THIS CONTRACT NUMBER MUST APPEAR ON ALL DOCUMENTS

3-2007

UNOCAL 76

This contract is entered into this 12th day of July, A.D., 199 1, between Union Oil Company of California, dba Unocal, with the force and effect of this Agreement limited to Union Oil Company of California's North American Oil and Gas Division, excepting Canada, and its Geothermal Division (hereinafter collectively COMPANY), P.O. Box 4531, Houston, Texas, 77210-4531, and Centech, Inc.

and any and all of its parent companies, subsidiaries and affiliates (CONTRACTOR) at 920 Lakeview Lane

Casper, WY 82604 (address). In exchange for the mutual covenants and conditions contained herein, COMPANY and CONTRACTOR agree as follows:

1. **DESCRIPTION OF SERVICE(S) TO BE PERFORMED BY CONTRACTOR**

CONTRACTOR, from time to time and upon receipt from COMPANY of instructions specifying the particular service to be performed and/or materials (including rented equipment) to be supplied, shall:

Provide clean up slop oil services as requested by Unocal.

It is understood between the parties herein that no performance is required hereunder except after receipt by CONTRACTOR of specific instructions from COMPANY, this Services and Drilling Master Contract (Contract) serving only to establish the terms and conditions of performance pursuant to any such instructions. Each set of such instructions shall be deemed a separate contract and transaction. If any conflict between such instructions and this Contract should arise, this Contract shall be controlling.

2. **TERMS OF PAYMENT**

COMPANY shall pay CONTRACTOR at the rates specified in CONTRACTOR'S published rates (including terms of payment) or at rates and terms agreed between COMPANY and CONTRACTOR for the above service(s) which rates and terms shall not be changed with less than 10 days written notice.

3. **TIME OF PAYMENT**

CONTRACTOR shall forward three (3) copies of the invoice with the job order ticket to COMPANY at the address of the COMPANY personnel requesting services hereunder who will provide billing information. Payment shall be due hereunder in the city of billing when all the work to be done by CONTRACTOR has been accepted by COMPANY as being in full compliance with all the terms, conditions, and requirements of this Contract, provided that on request of COMPANY, CONTRACTOR shall have satisfied COMPANY that there are no liens or lienable claims on or against COMPANY or its property by reason of the operations of CONTRACTOR hereunder.

CONTRACTOR shall reference all invoices or correspondence to this Contract's number and show the Outer Continental Shelf (OCS) destination for any material and equipment that will be delivered beyond the territorial waters of any state. Such material and equipment deliveries beyond the State of California territorial waters will be exempt from California sales and/or use tax in accordance with Section 6396 of the California Revenue and Taxation Code.

4. **DURATION OF CONTRACT**

This Contract may be terminated at the option of either party by giving the other party thirty (30) days notice in writing to that effect. For the purpose of giving this notice, or any notice that may be necessary in the performance of this Contract, the addresses of the parties hereto shall be and remain as shown above until notice by either party to the other, in writing, of a change of address. Notwithstanding the termination of this Contract, the parties shall continue to be bound by the provisions of this Contract that reasonably require some action or forbearance after such termination, including, but not limited to, Paragraphs 14. and 15.

5. **PAYMENT OF CLAIMS**

CONTRACTOR shall promptly pay all bills for labor and for materials purchased by it, or other indebtedness, involved in or arising out of this Contract, and shall, if required, exhibit receipted statements or invoices for all labor and material used.

6. **INDEMNIFICATION**

6.1 CONTRACTOR'S Indemnity. CONTRACTOR hereby agrees for itself and its officers, directors, agents, servants, employees and insurers (hereinafter referred to as "CONTRACTOR") to release, defend, and indemnify COMPANY and any of its parent, subsidiary and affiliated companies, its lessors, and its non-operators, joint venturers, partners, co-owners, or co-lessees (and their lessors) with COMPANY who wholly or partially bear the costs of operations and/or enjoy the benefits hereunder and the respective officers, directors, employees, agents or servants of each as well as the heirs, representatives, successors or assigns of each, if any, (hereinafter collectively referred to as OWNER), and its contractors and subcontractor(s) of any tier to the maximum extent permitted by the applicable law, in each and every case, irrespective of whether any indemnitee hereunder may be alleged or proven to have been negligent (including but not limited to active, passive, sole, joint, concurrent, comparative, contractual and gross negligence), or otherwise legally liable (with or without fault or whether strictly liable or in breach of any warranty), and, except in jurisdictions where prohibited, without limitation by reason of any insurance required by this Contract or maintained by CONTRACTOR, from and against any and all liability arising out of or in connection with the following:

a. Except with respect to down-hole equipment lost or damaged in the hole, all loss of or damage to CONTRACTOR'S equipment or property, or the equipment or property of contractors and subcontractors of any tier of CONTRACTOR as well as the property or equipment of the personnel of any of the foregoing arising out of or in connection with the operations under this Contract, regardless of how, when or where such damage or destruction occurs; and

b. All claims, liabilities, demands, actions, damages, losses, and expenses, including but not limited to court costs, reasonable attorney's fees, and other litigation expenses, arising out of or in connection with personal or bodily injury, illness, disease, or death to CONTRACTOR'S personnel, or the personnel of subcontractors of any tier of the CONTRACTOR, arising out of or in connection with the operations under this Contract, regardless of how, when, or where such injury, illness, disease or death occurs.

6.2 COMPANY'S Indemnity. COMPANY shall release, defend, and indemnify CONTRACTOR and its contractors or subcontractors to the maximum extent permitted by the applicable law, in each and every case, irrespective of whether CONTRACTOR or its contractors or subcontractors may be alleged or proven to have been negligent (including but not limited to active, passive, sole, joint, concurrent, comparative, contractual and gross negligence), or otherwise legally liable (with or without fault or whether strictly liable or in breach of any warranty), and without limitation by reason of any insurance maintained by either party, from and against any and all liabilities arising out of or in connection with the following:

a. All loss of or damage to COMPANY'S property or equipment or property or the equipment of COMPANY'S other contractors of any tier as well as the property or equipment of the personnel of any of the foregoing arising out of or in connection with the operations under this Contract, regardless of how, when or where such damage or destruction occurs; and

b. All claims, liabilities, demands, actions, damages, losses, and expenses, including but not limited to court costs, reasonable attorneys' fees, and other litigation expenses, arising out of or in connection with personal or bodily injury, illness, disease, or death to COMPANY'S personnel, or the personnel of COMPANY'S other contractors of any tier arising out of or in connection with the operations under this Contract, regardless of how, when, or where such injury, disease, or death occurs.

6.3 Underground Damage. COMPANY shall indemnify and hold CONTRACTOR harmless, without limit and without regard to the cause and regardless of any negligence of CONTRACTOR, excepting only CONTRACTOR'S gross negligence or willful misconduct, for any and all claims against CONTRACTOR based on any incident arising out of or occurring during the term of this Contract on account of injury to, destruction of, or loss or impairment of any property rights in or to oil, gas or other mineral substance or water, if at the time of the act or omission causing the injury, destruction, loss or impairment, the substances had not been reduced to physical possession above the surface of the earth, and for any loss or damage to any formation, strata or reservoir beneath the surface of the earth.

6.4 Pollution.

a. CONTRACTOR shall defend, indemnify and save harmless OWNER from and against all claims, demands and liabilities for property damage arising from pollution, including control and removal thereof, caused by CONTRACTOR'S negligent act or omission, whether active or passive, in performance of

facility field offices. Prior to bringing any hazardous material on-site, CONTRACTOR shall provide the COMPANY on-site supervisor a list of hazardous materials he intends to use on COMPANY facilities and a copy of the MSDS for each containing all information required by the Hazard Communication Standard. CONTRACTOR and CONTRACTOR'S employees may review COMPANY'S written Hazard Communications Program and any MSDS during working hours. Arrangements should be made by the CONTRACTOR on-site supervisor with the COMPANY on-site supervisor. Before performing any work for COMPANY or work on COMPANY property, the CONTRACTOR must contact the COMPANY on-site supervisor for instructions on safe procedures, protective equipment or other precautionary measures required with respect to possible exposure to hazardous materials or other hazards. Prior to beginning work the CONTRACTOR shall train his employees in accordance with the Hazard Communications Standard, including but not limited to COMPANY Safety Rules, appropriate COMPANY operations and safe procedures, protective equipment, and other precautionary information made available to the CONTRACTOR by COMPANY. Training will cover both normal operations and forseeable emergencies, and include information with respect to the use and availability of MSDS's and all labeling systems used by CONTRACTOR or COMPANY.

23. **DRILLING CONTRACT**

This paragraph 23 and its Subparagraphs apply to CONTRACTOR if CONTRACTOR is engaged by COMPANY to drill, complete, deepen, workover, repair, maintain or plug and abandon a well or wells set forth in a Bid Sheet and Drilling Order, hereinafter called ''Drilling Order'', which has been or will be submitted to it by COMPANY. CONTRACTOR shall complete the Drilling Order, setting forth the prices it proposes to charge for its services, and properly execute the Drilling Order in triplicate originals and return same to COMPANY. If COMPANY is satisfied with CONTRACTOR'S proposals, COMPANY shall execute the Drilling Order and return one original to CONTRACTOR. When the Drilling Order has been agreed to and executed in the manner hereinabove provided, that Drilling Order, including the terms and conditions of this Services and Drilling Master Contract, shall govern and control the work described thereon for COMPANY by CONTRACTOR.

23.1 Commencement of Operations. If and when the Drilling Order has been executed by the parties hereto, CONTRACTOR agrees to commence the operation specified at this time or on the date set forth in the Drilling Order, and to drill, complete, deepen, workover, repair, maintain or plug and abandon a well or wells as specified, with due diligence and without undue delays or interruptions, the well or wells covered thereby for the production of oil, gas, geothermal resources and/or other minerals or other service as specified by COMPANY, at the location, in the manner, to the depth, and in accordance with all of the provisions and specifications of this Contract and the Drilling Order.

23.2 Labor, Equipment and Materials. Material, equipment special tools, supplies, and services necessary or proper to the drilling and completion of the well shall be furnished at the drillsite by the party designated in the Drilling Order.

Should CONTRACTOR purchase for COMPANY at COMPANY'S request any materials, supplies, or equipment which COMPANY is obligated to furnish under the terms of this Contract or any Drilling Order, COMPANY agrees to pay CONTRACTOR within thirty (30) days after date of receipt of CONTRACTOR'S invoice the actual cost of such materials, supplies, or equipment, less any cash discounts thereon to which CONTRACTOR may be entitled.

23.3 Operational Requirements. CONTRACTOR further agrees to:

a. Keep an accurate record of work performed in an I.A.D.C. Daily Drilling Report book provided by CONTRACTOR, recording therein the nature, depth, and thickness of formation encountered. Such log shall at all times be subject to inspection by COMPANY or its representative; and, upon completion or abandonment of the well to which it pertains, shall become the exclusive property of COMPANY. All invoices are paid on the basis of these tour reports and each copy is to be signed by a COMPANY representative and CONTRACTOR'S representative.

b. Promptly notify COMPANY whenever any oil and/or gas-bearing formation is found. COMPANY shall be afforded sufficient time to examine said information to determine whether or not the well should be completed in same, and for such time consumed CONTRACTOR shall be paid applicable day work rates.

c. Use all possible care and diligence to keep fence gates open or closed as found, to avoid pollution of water bodies and courses and damage to any land by reason thereof, to avoid injury to any crops, fences, livestock, structures, and other property.

d. Have drill pipe, drill collars, subs, kelly and swivel furnished by CONTRACTOR inspected as specified in the Drilling Order.

e. Use the utmost diligence and highest degree of care to discover defects in materials and equipment supplied by CONTRACTOR and used by CONTRACTOR.

f. Turn in all delivery tickets covering any materials or supplies furnished by COMPANY or furnished by vendors for which COMPANY is obligated to reimburse CONTRACTOR as specified in the Drilling Order.

23.4 Default. In the event of default by CONTRACTOR, COMPANY shall have the right at its option either:

a. To terminate this Contract and do and cause to be done no further work on said drilling operation, other than that which may be required under applicable federal, state, or local authority, in which case COMPANY shall not be indebted to CONTRACTOR in any amount whatsoever, under this Contract, or

b. To take over the hole and itself do the work contracted to be done by the CONTRACTOR, or in good faith procure some other contractor to do the same, in which event COMPANY shall have the entire control of such work with the right to proceed with same or abandon as it sees fit, and to take and use or permit the use of CONTRACTOR'S tools and drilling equipment. In such event, the accounts between the parties shall be settled as follows:

All costs incurred by COMPANY, including expenditures on a second and subsequent hole in the event of the loss of any hole or holes, in doing or causing to be done, the work contracted hereunder to be done by CONTRACTOR, shall be at CONTRACTOR'S expense; accurate record of such costs shall be kept and the CONTRACTOR shall be credited thereon with the amount which would have been due CONTRACTOR for the performance of the work hereunder, after deduction of indebtedness or liens, if any, paid for CONTRACTOR by COMPANY. The accounts shall be settled by payment by one party to the other as the facts may require. For the protection of amounts due to COMPANY hereunder, it shall have a lien on all machinery, drilling equipment, and supplies of CONTRACTOR used or held for use in connection with the work hereunder. The costs incurred by COMPANY and charged to CONTRACTOR pursuant to this paragraph shall not in any event exceed the amount which would have been due CONTRACTOR for the performance of the work hereunder and which is to be credited against costs incurred by COMPANY as aforesaid; any excess costs shall be borne by COMPANY. All risks with respect to personal injury, death, property damage or other damage arising out of work performed by or for COMPANY pursuant to this paragraph shall be borne solely by COMPANY and COMPANY shall indemnify CONTRACTOR therefor.

In the event of conflict between this Subparagraph 23.4 and Paragraph 9 or Subparagraph 13.3, this Subparagraph 23.4 shall prevail.

23.5 COMPANY Access to Premises. The actual performance and superintendence of all work hereunder shall be by CONTRACTOR, but COMPANY or its representatives shall have unlimited access to the premises to determine whether work is being performed by CONTRACTOR in accordance with all of the provisions of this Contract and the Drilling Order.

23.6 Ingress and Egress to Location. COMPANY shall secure for CONTRACTOR rights of ingress and egress to the tract of land on which the well is to be drilled. COMPANY shall advise CONTRACTOR of any limitations or restrictions affecting ingress and egress, and CONTRACTOR shall abide by and shall have its employees, agents, or subcontractors abide by such limitations or restrictions. Should CONTRACTOR be denied free access to the location for any reason not within the control of CONTRACTOR, time lost by such denial shall be paid for at a reasonable rate in keeping with the stage of operations at the time.

23.7 Cancellation of Drilling Contract. This Contract may be cancelled by either party at any time upon thirty (30) days written notice to the other party as provided in Paragraph 4. However, the operations conducted under a Drilling Order may be terminated as provided therein.

23.8 Conflicts. In the event there is a conflict between the provisions of this Paragraph 23 and its Subparagraphs and any papers or documents, including the Drilling Order, which may have been executed or passed between the parties hereto in connection with the subject matter hereof, it is understood and agreed that the provisions of this Paragraph 23 and its Subparagraphs shall be controlling. If there is a conflict between the provisions of this Contract or any fully executed amendment of the Contract, and any such other documents, this Contract or amended Contract shall be controlling.

IN WITNESS WHEREOF, the parties have executed this AGREEMENT in duplicate as of the day and year first above written.

CONTRACTOR Certech, Inc.	Union Oil Company of California, dba Unocal Unocal North American Oil & Gas Division (excepting Canada) Unocal Geothermal Division
BY Neal J. Miller	BY [signature]
TITLE Pres.	TITLE Financial Accounting Manager
CONTRACTOR'S LICENSE NO. AND EXPIRATION DATE	WITNESS FOR COMPANY John O. Edwards

CONSTRUCTION CONTRACT

Date: July 7, 2003

Place: Newcastle, Wy

1. It is hereby agreed between Wyoming Pipe Line Co., a Wyoming corporation, located at 936 Highway 450, Newcastle, WY (herein called "**Company**"), and Centech, Inc of 920 Lakeview Lane, Casper, Wyoming (herein called "**Contractor**"), that Contractor will, as an independent contractor, construct and complete and furnish and pay for all material, labor, tools, equipment, utilities, and other facilities to construct and complete the following scope of work:

   The 35,000 barrels Butte tank has approximately 975 barrels of solid bottoms which will be removed by others into "Frac-Tanks" provided by the Company and located on site. Centech will provide all equipment necessary to handle, process, and separate these bottoms into water, solids, and merchantable crude oil. The Company will provide separate containment for the separated components.

   Centech will charge $4.75 per barrel processed, plus a $1,530 per day charge while on site, plus a lump sum of $4,200 mobilization/demobilization charge, plus a monthly charge of $4,325 for a portable 300 kilowatt generator. Estimated 9 day duration at 120 barrels per day results in a cost of Twenty-two thousand, seven hundred twenty and no/100's Dollars ($ 22,720.00) plus negotiated cost of generator in conformity with the terms hereof and the following contract documents which are attached hereto and made a part hereto and are listed as follows: Quote of June 20, 2003 .

2. Said work is to be commenced not later than August 15, 2003, and completed not later than August 30, 2003 .

3. Payment shall be made as follows; 100% of the work completed each month upon presentation of invoices in triplicate until 100% of the contract price has been paid. Final payment shall be made promptly upon completion of the work and its acceptance by Company and when Contractor furnishes proof satisfactory to Company that all bills for material and labor covering said work have been fully paid by Contractor, and that the premises upon which the work is done and the structure built, improved or added to are not subject to any material or labor liens or claims of liens. Contractor and/or any subcontractor shall promptly and satisfactory settle all claims for labor performed and supplies or materials furnished in connection with such work; and in the event Contractor fails or refuses to promptly and satisfactorily settle any such claims, Company shall, after so notifying Contractor in writing, have the right to settle such claims for the account of Contractor and deduct the amount thereof from amounts payable to Contractor. Payments falling due may be withheld in whole or in part when Company deems such withholding necessary to protect it from loss hereunder. It is further agreed and understood that the progress payments made hereunder shall not constitute full or partial acceptance of the work or any part thereof by, Company.

4. Company will provide at its expense standard "all risk" insurance covering the project with loss, if any, payable to Company and Contractor as their interest may appear. A certificate evidencing the coverage and exclusions under this insurance is available to Contractor upon request. Each loss shall be subject to a $500 deductible, said deductible to be borne by the party furnishing the materials and/or equipment that are lost.
   Contractor shall carry and pay for the following types of insurance coverage:

The rights and obligations of the parties as determined by any audit performed pursuant to this provision shall survive the termination of the contract.

ATTEST:

____

Company: **Wyoming Pipe Line Company**

By: Vern Johnson
Vern Johnson

Title: Manager

ATTEST:

____

Contractor: **Centech, Inc.**

By: [signature]

Title Pres.

SERVICES AGREEMENT

This ("Agreement") is made and entered into on this 20th day of April, 1993 between Western Production Company, whose post office address is 131-26 Highway 51, Gillette, Wyoming 82716 ("Owner"), and Centech, Inc., whose post office address is 920 Lakeview Lane, Casper, Wyoming 82604 ("Contractor").

It is agreed between the Owner and Contractor as follows:

1. WORK AND WARRANTIES.

Contractor shall provide all equipment as listed on the January 22, 1993 bid sheet and will perform clean up procedures to seperate oil, water and solids from the liquids in the Mushcreek Pit. All precedures will comply with Wyoming DEQ Guidelines, and any other state or federal laws applying to the cleanup procedure. The Contractor represents that it has familiarized itself with the site where the Work is to be performed including all conditions relating thereto and no claim for additional compensation will be allowed which is based upon lack of knowledge of such conditions.

2. CONTRACTOR'S OBLIGATION

Contractor shall provide the equipment with operator along with all maintenance required including any repairs, fueling, daily checks, etc. Contractor warrants that equipment and operators will meet all OSHA standards. Contractor will be responsible for any citations, fines, or assessments received by Contractors' operators or equipment in connection with this agreement.

7. INSURANCE AND INDEMNITY.

Contractor shall comply with all worker's compensation acts and obtain such insurance so as to protect Contractor from claims for damages arising out of the performance by the Contractor of this Agreement. Insurance shall be written for not less than $1,000,000 aggregate limit of liability and shall include both public liability and property damage liability insurance coverage, automobile liability insurance on all vehicles used, and such coverage shall include contractual liability coverages. The Contractor shall furnish Owner a certificate showing compliance with this provision. The Contractor agrees to protect, indemnify and save harmless Owner, its officers, agents and employees from and against all claims, demands, and causes of action for personal injury, death or property damages arising from the performance of this Agreement by the Contractor, its agents and employees.

8. COMPLETE AGREEMENT.

This written Agreement represents the complete agreement of the parties and shall not be modified except by an instrument in writing by both parties.

Dated as of the date first above written.

WYODAK RESOURCES DEVELOPMENT CORP.

By [signature]

Its President

APR 22 1993

CENTECH, INC.

By [signature] 4-22-1993

Its Pres

Amoco Production Company

WELL AND LEASE SERVICE MASTER CONTRACT

THIS AGREEMENT made this 1st day of July, 19 88, by and between Amoco Production Company, a corporation, hereinafter called "Amoco" and Centech, Inc., 920 Lakeview Lane, Casper, Wyoming 82604, hereinafter called "Contractor" whereby, in consideration of the covenants and provisions hereinafter provided, this agreement shall control and govern all work performed by Contractor for Amoco, under verbal or written workorders, at all times until canceled by either party.

1. Upon Amoco notifying Contractor in the manner provided above of the jobs required to be performed hereunder, Contractor will undertake the same and thereafter carry them on with due diligence and in a good and workmanlike manner to completion, subject, however, to Paragraphs 12 and 13 hereof.

2. In the performance of any operations hereunder Contractor shall furnish at its own expense and cost any and all necessary labor, machinery, equipment, tools, transportation and whatever else is necessary in the performance and completion of the work herein provided other than such items thereof as Amoco specifically agrees to furnish. Amoco will furnish, with due diligence and in a good and workmanlike manner, such labor, machinery, equipment, tools, transportation and other items as Amoco specifically agrees to furnish. If, in order to gain access to or return from the well to be serviced, it is necessary to repair roadbeds, or, to provide tractors, vessels, or other special means of transportation for the trucks, equipment, or personnel of Contractor, such shall be arranged and paid for by Amoco. Contractor shall be solely responsible for any loss or damage to his equipment, material, or supplies at all times except that Amoco shall be responsible for any loss or damage to equipment, material, or supplies of Contractor occurring during transportation by Amoco or by conveyance arranged for by Amoco to the extent of such loss or damage not covered by Contractor's insurance. The obligations of Amoco and the Contractor under this paragraph are subject to Paragraph 13 hereof.

3. Contractor agrees to pay and discharge all valid taxes, lienable claims, charges or other impositions imposed and to be imposed by law, on Contractor, arising out of, in connection with or resulting from, work performed hereunder, and to comply with all old age pension laws and unemployment laws, with reference to Contractor's employees engaged in the performance of any work hereunder. Contractor agrees to indemnify Amoco against any liability for any such taxes, lienable claims, charges or impositions; excepting from this indemnity, however, all taxes imposed on Contractor's services that are included in the consideration to be paid by Amoco to Contractor. If, upon the completion of any particular job, Amoco shall have cause to believe that there are unsatisfied claims for labor, materials, or injuries to third persons or property, it may request, and Contractor shall furnish, proof satisfactory to Amoco that such claims are satisfied or discharged. The amount due as herein provided shall be paid by Amoco to Contractor, subject, however, to the right in Amoco to withhold payments in accordance with the requirements of any applicable law with respect to liens for labor or material.

4. Contractor agrees at all times in the performance of this contract to abide by all valid rules and regulations prescribed by any governmental body having jurisdiction in the premises.

5. Contractor and each subcontractor shall maintain a true and correct set of records pertaining to work performed hereunder. Contractor and each subcontractor shall retain all records which are subject to inspection hereunder for the applicable statute of limitations period for the particular state in which the work was awarded. Neither Contractor nor any subcontractor shall pay any commissions or fees or grant any rebates or other remuneration or gratuity to any employee or officer of Amoco. Neither shall Contractor nor any subcontractor grant any secret rebates, one to the other, and neither shall Contractor nor any subcontractor pay any commissions or fees to the employees or officers of the other in connection with work performed hereunder. Amoco may, upon request, audit any and all records of Contractor and of any subcontractor relating to work performed hereunder; provided, however, Contractor and any subcontractor shall have the right to exclude any trade secrets, formulas or processes from such inspection.

6. Contractor shall be an independent contractor with respect to all work done and services performed hereunder, and neither Contractor nor anyone used or employed by Contractor shall be deemed for any purpose to be the agent, servant or representative of Amoco in the performance of such work or services or any part thereof, or in any matter dealt with herein, and Amoco shall have no direction or control of Contractor, or its employees and agents, except in the results to be obtained. It is understood that, by this provision, neither party is assuming any liability for the actions or omissions of the other party, except as is stated in this contract. It is agreed, however, that Contractor shall not be liable for damage to property owned by Amoco, unless such damage is caused by the negligence of the Contractor, it being the intent of the parties hereto that his provision shall apply, but not be restricted to subsurface damage and surface damage arising from subsurface damage.

7. Notwithstanding other provisions of this contract, Amoco shall be responsible for and shall secure Contractor against any liability for reservoir loss or damage, or property damage arising from a well blowout, unless such damage is caused by the wilful negligence of Contractor.

8. All notices to be given under this contract shall be in writing and shall be sent to Contractor at 920 Lakeview Lane, Casper, WY 82604, and to Amoco at P. O. Box 2520, Casper, WY 82602

9. The consideration to be paid by Amoco to Contractor shall be the amount set forth in the rate schedule furnished Amoco prior to the commencement of work or, if no schedule be furnished, the amount shown in the applicable work order of Amoco; provided, however, that the amount to be paid for any service or labor or material furnished or used in connection with such work shall not exceed Contractor's usual and customary charge for such services, labor or material in the locality where the work is to be performed.

10. In order to eliminate controversies between Contractor, its Subcontractors and Amoco and its joint owners, if any, and their respective insurers, Contractor assumes all liability for and hereby agrees to defend, indemnify and hold Amoco, its joint owner or owners, if any, and their insurers, harmless from and against any and all losses, costs, expenses and causes of action, including attorney's fees and court costs, for injuries to and death of Contractor's and its Subcontractor's employees, arising out of, incident to, or in connection with any and all operations under this contract and whether or not such losses, costs, expenses and causes of action are occasioned by or incident to or the result of the negligence of Amoco, its joint owner or owners, if any, and its agents, representatives and employees. Contractor agrees to insure this assumption of liability. The liability assumed by Contractor pursuant to this clause shall be limited to the amounts carried by Contractor's current liability insurance, but in no event shall it be less than the minimum limits set out in Paragraph 11 (b), below.

11. As to all operations provided for herein, Contractor shall secure and maintain during the term of this agreement the following insurance:

(a) Workmen's Compensation Insurance which shall fully comply with the requirements of state laws as well as federal laws, if applicable.

(b) Comprehensive General Liability Insurance, including Contractual Liability coverage, with minimum limits of $100,000 each person and $300,000 each occurrence for Bodily Injury and $100,000 each occurrence for Property Damage.

(c) Automobile Liability Insurance covering owned, hired and non-owned vehicles used by Contractor with minimum limits of $100,000 each person and $300,000 each occurrence for Bodily Injury and $100,000 each occurrence for Property Damage.

If requested by Amoco, Contractor shall furnish Amoco insurance certificates to evidence the insurance required herein. Maintaining the prescribed insurance shall not relieve Contractor of any other obligation under this Agreement.

12. This contract does not obligate Amoco to order work from Contractor, nor does it obligate Contractor to accept orders for work, but it, together with any applicable work order, shall control and govern all work accepted by Contractor and shall define the rights and obligations of Amoco and Contractor, during the term hereof.

13. This Contract is subject to all laws, orders, rules, and regulations, and neither Amoco nor Contractor shall be liable for any delay or damage due, occasioned or caused as a result of such laws, orders, rules or regulations, or by strikes, action of the elements, or causes beyond the control of the parties; and any delay due to above causes or any of them, shall not be deemed to be a breach of or failure to perform this Contract, or any part thereof.

14. If equipment or instruments of Contractor are lost in the well, Amoco shall either recover same without cost to Contractor or pay for such equipment or instruments, unless, however, such loss is caused by the negligence of Contractor.

15. In requesting the services of Contractor, Amoco assumes full responsibility for compliance with the rules and regulations of the governmental agencies regulating the lease production and for designating the premises upon which such services are to be performed.

16. Contractor may not assign or sublet this contract, or any part thereof, without the written consent of Amoco, and the assignment of this contract, or the subletting of any work to be performed hereunder, if so permitted by Amoco, shall not relieve Contractor of its obligations hereunder. It is agreed, however, that Contractor shall retain the right to assign all or any part of the remuneration due, or which may become due, by virtue of work performed under this contract.

17. Should Contractor become insolvent or make an assignment for the benefit of creditors or be adjudicated a bankrupt or admit in writing his inability to pay his debts generally as the same become due, or should any proceedings be instituted by Contractor under any State

or Federal law for relief of debtors or for the appointment of a receiver, trustee or liquidator of Contractor, or should a voluntary petition in bankruptcy or for a reorganization or for an adjudication of Contractor as an insolvent or a bankrupt be filed, or should an attachment be levied upon Contractor's equipment and not removed within five (5) days therefrom, then upon the occurrence of any such event, Amoco shall thereupon have the right to cancel this contract and to terminate immediately all work then being performed by Contractor hereunder.

18. Contractor in connection with the performance of work under this contract relating to leases of the United States agrees to comply with the provisions set forth in Exhibit "A" attached hereto and made a part hereof.

WITNESS THE SIGNATURES of the parties hereto the day and year first above written.

WITNESS: L. Clark

Amoco Production Company

By

WITNESS: Evelyn McClure

Centech, Inc.

Contractor

Amoco Production Company

Post Office Box 2520
Casper, Wyoming 82602
307-265-7211

M. D. Castleberry
District Manager

To whom it may concern:

Amoco Production Company worked with Neal Miller from October 1984 through July 1985 in developing and refining the use of a 3 - stage horizontal centrifuge for cleanup of contaminated crude oil. The test that was conducted was a success and Neal consistently cleaned the crude oil to less than 0.3% sediment and water.

Neal was first approached about utilizing the 3 - stage unit to attempt to clean up a low gravity (approximately 21 API gravity) crude that was used for a coring operation. There was approximately 1500 barrels of this crude and it was loaded with drilling mud and formation fines from the coring operation. It was also in a very emulsified state and the overall condition had to be about as tough a test as could be presented to Neal. However, he was able to develop the proper operating method (Rate, Temperature, Etc.) to effectively handle the test and provide a saleable crude (less than 0.3% sediment and water).

During the later period of the test Neal easily handled a total of approximately 2,200 barrels of 35 API gravity crude that was recovered from pits and water flood supply tanks. This particular test fluid consisted of approximately 15-20% solids content and 10-15% water. Neal easily demonstrated the ability to remove the solids and water to a very acceptable and saleable level. He consistently performed this portion of the test at an approximate 60 GPM rate.

In conclusion I feel very confident of Neal's ability to utilize the 3 - stage centrifuge in a cost effective manner to clean up contaminated crude oil to specified requirements.

Philip F. Clasen, Jr.

Philip F. Clasen, Jr.
District Foreman

MASTER SERVICE CONTRACT

THIS AGREEMENT, made and entered into this 28th day of October, 19 91, by and between the True owned and operated Industries (a listing of which is attached hereto as Exhibit "A" and incorporated herein) P. O. Drawer 2360, Casper, WY 82602, herein designated "Company," and Centech, Inc. a Wyoming Corporation
920 Lakeview Lane
Casper, Wyoming 82604
, herein designated "Contractor."

WITNESSETH:

WHEREAS, Company may from time to time desire Contractor to perform work and/or provide items of equipment, machinery, materials or supplies for Company's operations; and,

WHEREAS, Company and Contractor desire to establish certain general terms and conditions which shall apply to and become part of each and every contract, whether written or oral, entered into between the parties.

NOW, THEREFORE, in consideration of the mutual promises and agreements herein contained, the parties hereto mutually agree as follows:

1. This Agreement shall control and govern all work and/or equipment or materials furnished by Contractor for Company (hereinafter sometimes referred to as "Contractor's Performance") under subsequent verbal and/or written work orders during the term of this Agreement. In the event there is a conflict between the provisions herein and any oral or verbal contract or work order between the parties hereto in connection with the subject matter herein, it is understood and agreed that the provisions herein shall be controlling. It is expressly understood and agreed by the parties hereto that no provision of any delivery ticket, purchase order, invoice or other instrument used by Contractor or Company in setting forth the work to be conducted herein shall supercede the provisions of this agreement unless specific reference to this agreement is made therein and said instrument is signed by an officer or other duly designated representative of each party.

2. This Agreement shall continue in full force and effect for a term of one (1) year from the date this Agreement is made and from year to year thereafter unless terminated by thirty (30) days' written notice by one party hereto to the other party at the respective addresses specified herein for notices. Such termination shall not relieve either party of its respective obligations and liabilities arising from or incident to work performed hereunder prior to the date of termination.

3. This Contract does not obligate Company to order work and/or equipment or materials from Contractor, nor does it obligate Contractor to accept such orders, but it, together with any applicable work order, shall control and govern all work performed and/or equipment and/or items of equipment or materials supplied by Contractor and shall define the rights and obligations of Company and Contractor, during the term hereof.

4. The Company shall pay Contractor for the work and/or equipment or materials furnished by Contractor at the rate stipulated in the work orders provided for herein, subject to same being accepted by Company as fully complying with all the terms, conditions, specifications and requirements of this Contract and such work orders. In connection with Contractor's Performance for Company, Contractor shall pay all legal claims for labor and material and agrees that it will not permit any liens of any kind to be affixed against the property of Company or the lease or property of others arising out of claims of Contractor's employees, mechanics, or materialmen, and upon the completion of any job, Contractor shall, if requested, furnish Company with satisfactory evidence of the payment of all such claims. Contractor agrees to indemnify Company from and against all such claims or liens, and further agrees that any sums due to Contractor by Company may be withheld and applied toward the discharge or payment of any such claims or liens.

5. Copies of delivery tickets covering all work and/or equipment or materials furnished by vendors for which Company is obligated to reimburse Contractor, shall be turned in to Company with Contractor's invoice. The quantity, description and condition of materials

21. Special Provisions:

IN WITNESS WHEREOF, the parties hereto have executed this Contract upon the date above shown in several counterparts, each of which shall be considered as an original.

"COMPANY"

THE TRUE OWNED AND OPERATED INDUSTRIES
(Set forth on Exhibit "A" hereto)

By Henry True
Its Vice President

Address: P. O. Drawer 2360
Casper, WY 82602

"CONTRACTOR"

Centech, Inc.

By Neal Muller
Position Pres.

Address:
Centech, Inc.
920 Lakeview Lane
Casper, Wyoming 82604

ATTEST:

____

SM

MSCTI 8/16/90

GENERAL CONTRACT

Date Sept. 4, 2001

1. It is agreed between Cenex Harvest States Cooperatives d/b/a Cenex Harvest States Cooperatives ("Cenex Harvest States Cooperatives"), and CENTECH, INC. of 920 LAKEVIEW LANE, CASPER, WY 82604 ("Contractor") that Contractor will, as an independent contractor, construct and complete with reasonable diligence and dispatch and furnish and pay for all material, labor, tools, equipment, utilities, and other facilities to construct and complete WORK AS DIRECTED / SCOPE OF WORK ("Work") in conformity with terms hereof and the following contract documents which are incorporated by reference and made a part hereof and are listed as follows: 3 Phase Separation of tank Bottoms Sludge Ect. for the sum of COST PLUS / LUMP SUM.

2. **Completion Date**

The Work shall be commenced not later than September 10, 2001, and completed not later than September 9, 2002 ("Completion Date"). This contract shall be effective on September 10, 2001. Contractor's obligation hereunder is to complete the Work and to meet the deadline(s) set forth in the contract documents.

3. **Payments: Liens**

3.1 Payment shall be made as follows: 100 % of the Work completed each month shall be paid within 30 days of presentation of invoices (all duplicates shall be marked "copy"), subject to approval of the invoices by Cenex Harvest States Cooperatives, until 100 % of the contract price has been paid. All payments to Contractor hereunder shall be used to first satisfy the accounts directly related to the Work. Payments due may be withheld in whole or in part if Cenex Harvest States Cooperatives deems such withholding necessary to protect it from claim or loss due to Contractor's failure to comply with this Item 3 or other provision(s) of this contract. Final payment shall be made promptly upon Final Acceptance by Cenex Harvest States Cooperatives and when Contractor furnishes proof satisfactory to Cenex Harvest States Cooperatives (which may include waivers and releases from all lower tier subcontractors and suppliers) showing that all bills for material and labor have been fully paid by Contractor and that the premises are not subject to any liens or claims of liens. The progress payments made hereunder shall not constitute full or partial acceptance of the Work or any part thereof by Cenex Harvest States Cooperatives.

3.2 Contractor shall promptly pay all costs incurred by Contractor in performing the Work and shall take all action reasonably necessary (a) to avoid the attachment of a lien on Cenex Harvest States Cooperatives' property or (b) to remove any lien on Cenex Harvest States Cooperatives' property arising from the Work. Contractor

38. **Entire Agreement and Contract Modification**

This contract sets forth the entire agreement between Contractor and Cenex Harvest States Cooperatives with respect to its subject matter. Except for any prior nondisclosure agreements between the parties hereto, all prior negotiations and dealings regarding the subject matter hereof are superseded by and merged into this contract. No modification of this contract shall be effective unless made in writing and signed by both parties.

39. **Employer's Registration Numbers**

Contractor is, and during performance hereof will continue to be, registered for tax purposes as an employer under applicable federal and other laws, and Contractor's employer's registration numbers thereunder are:

Federal ID No. 45-0397962 State ID No. 1990-00261056

CONTRACTOR

By: [signature]

Its: Pres.

COMPANY

CENEX HARVEST STATES COOPERATIVES

By: [signature]

Its: VP Energy Operations

SECTION THREE

ATTACHMENT NO. 2

BEST ENVIRONMENTAL PRACTICES
WASTE MANAGEMENT CHECKLIST

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644

3444 Burd Road, Casper, Wyoming 82601

BEST ENVIRONMENTAL PRACTICES
WASTE MANAGEMENT CHECKLIST

Best environmental practices waste management integrates environmental policies and standards, planning, training, communications, documentation, assessment, compliance accountability, and management review processes to ensure superior environmental performance. Centech International incorporates the following environmental waste management practices as key elements of its Waste Management Program:

- Established Environmental Policies and Standards
- Facility/Site Operating plan
- Documentation/Record Keeping/Reporting
- Environmental Safety & Health Plan, QA/QC Measures
- Employee training
- Site security
- Wildlife protection
- Community relations
- Inspection/Monitoring/Compliance Accountability
- Maintenance
- Pollution prevention
- Waste acceptance plan
- Waste tracking
- Waste testing
- Cross-media impacts
- Secondary disposal

(1) Appropriate measures to limit access to the centralized facility by wildlife, domestic animals, and members of the general public shall be implemented.

(2) Operating plan: An operating plan, including, but not limited to, a detailed description of the method of treatment, loading rates, application of nutrients and soil amendments, dust and moisture control, sampling, inspection and maintenance, emergency response, record-keeping, site security, hours of operation, and final disposition of waste. Where treated waste will be beneficially reused, a description of reuse and method of product quality assurance shall be included.

(3) Facility design and engineering. Facility design and engineering data, including plans and elevations, design basis, calculations, and process description.

(4) Operators shall ensure that oil production waste (E&P waste) is properly stored, handled, transported, treated, recycled or disposed to prevent threatened or actual significant adverse environmental impacts to air, water, soil or biological resources or to the extent necessary to ensure compliance with the established allowable concentrations.

(5) E&P waste management activities shall be conducted, and facilities constructed and operated, to protect local water streams from significant adverse environmental impacts from E&P waste, except as permitted by applicable laws and regulations.

(6) Ground water monitoring: When applicable or as directed by regulatory agencies ground water monitoring is conducted for the purpose of preventing and mitigating threatened or actual significant adverse environmental impact or to ensure compliance with the allowable concentrations and levels.

(7) Reuse and recycling: To encourage and promote waste minimization, plans may be proposed for managing E&P waste through beneficial use, reuse and recycling. Such plans shall describe the proposed use of the waste, method of waste treatment, and product quality assurance.

(8) Waste profile: For each type of waste, the amounts to be received and managed by the facility shall be estimated in accordance with established guidelines. For each waste type to be treated, a characteristic waste profile shall be completed.

(9) Spills and Releases: Spills/releases of E&P waste, including produced fluids shall be controlled and contained immediately upon discovery. Impacts resulting from spills/releases shall be investigated and cleaned up as soon as practicable. The Director may require additional activities to prevent or mitigate threatened or actual significant adverse environmental impacts on any air, water, soil or biological resource, or to the extent necessary to ensure compliance with the established allowable concentrations and levels.

(10) Oily Waste: Oily waste includes those materials containing crude oil, condensate or other hydrocarbon-containing E&P waste, such as soil, frac sand, drilling fluids, workover fluids, pit sludge, tank bottoms, pipeline pigging wastes, processing and storage wastes.

- ▶ Free oil shall be removed from the oily waste prior to land treatment.
- ▶ Oily waste shall be spread evenly to prevent pooling, ponding or runoff.
- ▶ Contamination of ground water or surface water shall be prevented.
- ▶ Biodegradation may be enhanced by disking, tilling, aerating, addition of nutrients, microbes, water or other amendments, as appropriate.
- ▶ Land-treated oily waste incorporated in place shall not exceed the established regulatory allowable concentrations.

(11) Facility modifications: Throughout the life of the facility the operator shall submit proposed modifications to the facility design, operating plan, permit data, or permit conditions to the appropriate authority for prior approval.

(12) Remediation: Remediation shall be performed in a manner to mitigate, remove or reduce contamination that exceeds the allowable concentrations in order to ensure protection of public health, safety and welfare, and to prevent and mitigate significant adverse environmental impacts. Soil and ground water that does not meet allowable concentrations shall be remediated in accordance with a Site Investigation and Remediation Plan.

(13) Assessment reviews: To ensure compliance with permit conditions and regulatory requirements the waste management facility/project site shall be subject to periodic and annual assessments by appropriate regulatory agencies as applicable.

SECTION THREE

ATTACHMENT NO. 3

ISO 9001:2000 CERTIFICATE
ISO 14001:2004 CERTIFICATE
OHSAS 18001 CERTIFICATE

NOTE: See Continuation #2 noted in Section Three-Continuations.

SECTION FOUR

APPLICANTS CURRENT WORKLOAD

SECTION FOUR – APPLICANT'S CURRENT WORKLOAD

1. Attach (as **Attachment No.1** to Section Four) a listing of all the contracts related to Waste Management/ Environmental Services presently under progress, including the following information:

   - Name of client, address, telephone and fax numbers, contact persons and e-mail addresses.
   - Contract title, location and Type.
   - Applicant's scope of service, contract price (approximate)
   - Date of commencement, due date of completion and percentage of the work completed.
   - Percentage of contract subcontracted out, and the nature of the service subcontracted and names of subcontractors
   - If the Contract was part of a larger Contract, state percentage of the larger Contract, which that contract represented.

Signature: Ernest W. Alexander

Name: **Ernest W. Alexander**

Name and Title of Authorized Signatory: **Managing Director**

Applicant's Company Name: **Centech International LLC**

Applicant's Company Stamp:

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

SECTION FOUR

APPLICANT'S CURRENT WORKLOAD

ATTACHMENT NO. **1**

LIST OF CONTRACTS

MASTER SERVICE AGREEMENT

THIS AGREEMENT CONTAINS PROVISIONS REQUIRING ONE PARTY TO BE RESPONSIBLE FOR THE NEGLIGENCE, STRICT LIABILITY OR FAULT OF THE OTHER PARTY

THIS MASTER SERVICE AGREEMENT ("Agreement") is made and entered into this 11th day of April, 2006, between EnCana Oil & Gas (USA) Inc., ("EnCana"), and **Centech Inc.** ("Contractor"). This Agreement shall govern the Work performed by Contractor for EnCana in conjunction with one or more Work Orders.

1. Definitions.

a. "Affiliate" means, with respect to a party, any individual, partnership, corporation or other entity directly or indirectly controlling, controlled by, or under common control with the party.

b. "Contract Price" shall mean the compensation for goods and/or services that EnCana and Contractor agree will be paid to Contractor at the time and in the manner provided for in a Work Order.

c. "Contractor Group" shall mean Contractor, its Affiliates and Subcontractors, and their respective directors, officers, employees, representatives and agents.

d. "Contractor Representative" means the individual designated by Contractor to represent Contractor in connection with all matters related to the Work.

e. "Defect" means an error, fault, or nonconformance with relevant specifications for material or equipment supplied, or goods sold, or in services provided by Contractor or its Affiliate or Subcontractor.

f. "EnCana Representative" means the individual designated by EnCana to represent EnCana in connection with all matters related to the Work.

g. "EnCana Group" shall mean EnCana (as defined above), co-owners at the Site, joint venturers, partners, other contractors and subcontractors, and their respective directors, officers, employees, representatives and agents.

h. "Proprietary Information" shall mean information which Contractor or a Subcontractor acquires from EnCana, directly or indirectly, and all information which arises out of or is related to the Work, and all proprietary processes involved in the Work, including, without limitation, information concerning EnCana's present and future business plans and information about EnCana's operations. Proprietary Information shall not include information (i) which, at the time of disclosure, is in the public domain; (ii) which enters the public domain after disclosure, except where such entry is the result of Contractor's or a Subcontractor's breach of this Agreement; (iii) which, prior to disclosure, was already in Contractor's or in the Subcontractor's possession without limitation on disclosure to others; or (iv) which, subsequent to disclosure, was obtained by Contractor or by the Subcontractor from a third party who is lawfully in possession of the information and is not subject to a contractual or fiduciary relationship with EnCana with respect to said information.

i. "Site" shall mean the location at which Contractor is performing the Work for EnCana.

j. "Subcontractor" shall mean a party that Contractor engages to perform all or a part of the Work.

k. "Warranty Period" means (i) in the case of goods, material or equipment supplied or sold, the period commencing on the date the goods, materials or equipment are received by EnCana or, if installed by Contractor, the date of such installation, and ending twelve (12) months thereafter, and (ii) in the case of services provided, the period commencing the date Contractor completes such services and ending twelve (12) months thereafter.

l. "Work" shall mean the performance of work, provision of services and/or the supply or sale of goods, material or equipment by Contractor to EnCana from time to time under a particular Work Order.

m. "Work Order" shall mean the directions from EnCana to Contractor, which may be oral or written, to provide EnCana with Work at a specific time, place and cost, as shown on Exhibit "A".

2. Conduct of Work. Contractor shall perform the Work with due diligence and in a good and workmanlike manner to completion.

a. Contractor's Responsibilities. Contractor, at its sole cost, risk and expense, shall:

i. Furnish the services of all personnel and supervisors required to complete the Work.

ii. Supply all machinery, equipment, tools, materials, transportation, and supplies required to complete the Work. Contractor shall store all such machinery, equipment, tools, and supplies in an orderly manner in a designated storage area at the Site.

iii. Provide all necessary safeguards, as are dictated by current industry standards, for the protection of all aspects of the Work and all persons involved in the Work.

iv. Obtain and provide evidence to EnCana of all permits and licenses that are required to perform the Work, except for air permits and EPA permits.

v. Pay (1) any occupation or similar taxes and all sales, use or consumer taxes required; (2) all payroll taxes, and charges for social security, unemployment compensation, retirement pensions or benefits, that are required to be made with respect to the wages and salaries of persons employed by Contractor that are imposed by federal or state laws; and (3) for all labor and materials furnished by Contractor for the Work and the charges of all Subcontractors.

vii. Take such other action as may be requested by EnCana and agreed to by Contractor. Contractor shall be responsible for Work performed, material and equipment supplied, and goods sold, by an Affiliate, Subcontractor, vendor or supplier of Contractor.

b. EnCana's Responsibilities. EnCana shall:

i. Furnish materials and equipment, if any, which EnCana has agreed to furnish in the applicable Work Orders.

ii. Provide the Site for the Work and access to the Site, with adequate space on or near the Site as may be necessary for Contractor's office, warehouse, materials storage and employee parking.

iii. Furnish necessary construction utilities.

3. Payment of Contract Price/Invoicing. The Contract Price shall be due the later of (i) the date the Work is found to be satisfactory by EnCana, or (ii) thirty (30) days after EnCana's receipt of an invoice for the Work. Contractor shall submit invoices and supporting documents electronically utilizing EnCana's OpenInvoice System. If this system is not available, Contractor shall submit invoices to:

Accounts Payable
EnCana Oil & Gas (USA) Inc.
370 17th Street, Suite 1700
Denver, CO 80202

4. Warranties.

a. For services provided, Contractor warrants for the Warranty Period that the services are in accordance with the specifications set forth in the applicable Work Order; that they have been completed in accordance with applicable codes and in accordance with sound engineering practices.

b. For goods sold or material and equipment manufactured or supplied by Contractor or a Subcontractor, Contractor warrants good and merchantable title to such goods, material or equipment; that they will be free from Defects in material and workmanship during the Warranty Period; that they will conform to applicable specifications, and drawings set forth in the applicable Work Order; or not manufactured or produced to designs that EnCana furnishes, will be free from Defects in design during the Warranty Period.

c. EnCana may require Contractor, at no cost to EnCana, to redesign, resupply or otherwise correct a Defect or to otherwise remedy a breach of the foregoing warranties, whether or not the Work has been accepted.

5. Inspection and Acceptance.

a. Inspection and Testing of Components. Contractor shall be responsible for inspecting and testing materials and equipment that constitute part of the Work. The EnCana Representative shall have the right at any time to inspect and test the Work at all places and stages of production and installation, without such action being treated as either discharging Contractor's responsibility or constituting acceptance of the work.

b. Care, Custody and Control. When Contractor determines that the Work or a discrete portion of the Work is ready for initial start-up operation or service, the Contractor Representative shall advise the EnCana Representative in writing and the care, custody or control of Work or such portion thereof shall pass to EnCana unless the EnCana Representative advises Contractor within five days thereafter that the Work or the portion of the Work is not ready for initial start-up operation or service. EnCana shall assume risk of loss or damage from and after the date of transfer. Transfer of care, custody and control of the Work or a portion of it to EnCana pursuant to this Section 5.b. does not constitute acceptance pursuant to Section 5.c.

c. Acceptance of the Work. Within fifteen (15) days after either performance tests are completed or the transfer of care, custody and control of all of the Work to EnCana, the EnCana Representative shall advise Contractor in writing of any Defects in the Work EnCana has discovered. If the EnCana Representative does not give notice of Defects within the fifteen (15) day period, or if after Contractor corrects the Defects the EnCana Representative does not advise Contractor in writing within ten (10) days of the completion of such corrective action of any further Defects, EnCana shall be deemed to have accepted the Work; provided, however, that Contractor shall remain responsible for any Defects discovered during the Warranty Period pursuant to Section 4.

6. Patents. Contractor shall defend, indemnify and hold the EnCana Group harmless from and against any action, claim or demand, and all costs and expenses, including attorneys' fees, that arise in connection with any infringement or alleged infringement of U.S. Letters Patent, trademark or copyright laws with respect to the Work.

7. Proprietary Information; Advertising. Contractor shall not use any Proprietary Information except in connection with the Work and shall not disclose any Proprietary Information or details of the Work to any third party except to those who are to perform the Work, and then only to the extent that such disclosure is required to perform the particular portion of the Work and only if the third party agrees in writing to keep such Proprietary Information confidential. Contractor shall take all reasonable precautions to safeguard any documents containing Proprietary Information which EnCana provides to Contractor under this Agreement. Contractor shall obtain the EnCana Representative's prior approval of any photographs and the text of any announcement or publication concerning the Work that either Contractor or any Subcontractor wishes to make.

8. Risk of Loss; Liens; Clean-up.

a. Risk of Loss. Contractor is responsible for and shall replace, repair or reconstruct and shall furnish such material, equipment or supplies that it furnishes for the Work which are lost, stolen, damaged or destroyed prior to the

time that care, custody and control thereof are transferred to EnCana pursuant to Section 5.b., regardless of the cause of the loss, theft, damage or destruction.

b. Liens. Contractor shall make timely payments to all workmen, materialmen and Subcontractors and take all other action necessary to keep the Site and the Work free of third party liens. EnCana may withhold payment of amounts due to Contractor until it has been furnished with proof satisfactory to it that either all amounts have been paid or Contractor has provided for satisfactory payment. If a third party lien attaches to the Site of the Work, EnCana may make any payment necessary to discharge the lien, and it may offset the amount of the lien together with damages, court costs and reasonable attorneys' fees that it incurs because of the lien or its discharge, against any payment owing or to be owed to Contractor. Notwithstanding the foregoing, EnCana agrees that it will not pay any such claim or indebtedness as long as same is being actively contested by Contractor and Contractor has taken all actions necessary (including the posting of a bond when appropriate) to protect the property interests of EnCana and any other party affected by such claim or indebtedness. CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE ENCANA GROUP HARMLESS FROM AND AGAINST ANY THIRD PARTY LIENS ARISING OUT OF OR CONNECTED WITH THE WORK, INCLUDING COURT COSTS AND REASONABLE ATTORNEYS' FEES INCURRED AS A RESULT OF SUCH THIRD PARTY LIENS.

c. Clean-up. Contractor shall remove its material and equipment from the Site upon completion of the Work and shall clean up the Site in a good and workmanlike manner. If Contractor fails to remove its material and equipment and clean up the Site within thirty (30) days after completion of the Work, EnCana may remove the materials and equipment and clean up the Site at Contractor's expense and deduct its costs from sums that EnCana owes Contractor.

9. Maintenance and Audit of Records. Contractor shall maintain for not less than two (2) years after the Work is completed, complete and accurate records (including invoices, payroll sheets and supporting documentation), of all costs which have been charged or are chargeable to EnCana. EnCana shall have the right at any reasonable time to inspect and audit Contractor's records related to the Work. If errors are found in billings or payments, the parties shall promptly adjust and correct the errors.

10. Indemnities.

a. Contractor hereby agrees to release, defend, indemnify and hold the EnCana Group harmless from and against any and all loss, cost, damage or expense of every kind and nature (including, without limitation, fines, penalties, remedial obligations, court costs and expenses and reasonable attorneys' fees, including attorneys' fees incurred in the enforcement of this indemnity provision (hereinafter referred to collectively as "Indemnifiable Claims")), arising out of bodily injury (including sickness to or death of persons and losses therefrom to relatives or dependents) to the Contractor Group, or loss or destruction of property or interests in property of the Contractor Group, in any manner caused by, directly or indirectly resulting from, incident to, connected with or arising out of performance of the Work, WHETHER OR NOT RESULTING IN WHOLE OR IN PART FROM THE SOLE, CONCURRENT, OR COMPARATIVE NEGLIGENCE, OR STRICT LIABILITY OF THE ENCANA GROUP, OR ANY DEFECT IN THE PREMISES, EQUIPMENT OR TOOLS OWNED, OPERATED OR CONTROLLED BY THE ENCANA GROUP. Contractor agrees that this voluntary and mutual indemnity agreement will be supported by insurance of the types and in at least the minimum amounts required in Section 11, and shall be primary to any other insurance provided by the EnCana Group.

b. EnCana hereby agrees to release, defend, indemnify and hold the Contractor Group harmless from and against any and all Indemnifiable Claims arising out of bodily injury (including sickness to or death of persons and losses therefrom to relatives or dependents) to the EnCana Group, or loss or destruction of property or interests in property of the EnCana Group, in any manner caused by, directly or indirectly resulting from, incident to, connected with, or arising out of the performance of the Work, WHETHER OR NOT RESULTING IN WHOLE OR IN PART FROM THE SOLE, CONCURRENT, OR COMPARATIVE NEGLIGENCE, OR STRICT LIABILITY OF THE CONTRACTOR GROUP, OR ANY DEFECT IN THE PREMISES, EQUIPMENT OR TOOLS OWNED, OPERATED OR CONTROLLED BY THE CONTRACTOR GROUP. EnCana agrees that this voluntary and mutual indemnity agreement will be supported by insurance of the types and in the amounts required of Contractor by Section 11, and shall be primary to any other insurance provided by the Contractor Group.

c. Contractor hereby agrees to release, defend, indemnify and hold the EnCana Group harmless from and against any and all Indemnifiable Claims by third parties (*i.e.*, parties not included in the EnCana Group or Contractor Group) arising out of bodily injury (including sickness to or death of persons and losses therefrom to relatives or dependents) or loss or destruction of property or interests in property in any manner caused by, directly or indirectly resulting from, incident to, connected with or arising out of the performance of the Work, unless such injury or loss of property is due to the sole negligence of the EnCana Group.

d. Each party shall be responsible for, and hereby agrees to defend, indemnify and hold the other party harmless from and against, any and all Indemnifiable Claims arising out of or with respect to, the emission, discharge or release by such indemnifying party or by a Subcontractor of such indemnifying party, in connection with the Work, or transportation to and from the Site, of chemical pollutants, contaminants, waste, petroleum waste, used oil, toxic substances, hazardous substances or any other substances that are regulated by any governmental entity under environmental laws.

e. Notwithstanding any provisions of this Section 10 to the contrary, the following provisions shall apply to operations involved in the drilling of an oil or gas well:

i. EnCana hereby releases and agrees to defend, indemnify and hold the Contractor Group harmless from and against any and all Indemnifiable Claims arising from pollution or contamination below the surface of the land, seabed or water, resulting from blowout, fire, cratering, seepage or any other uncontrolled flow of oil, gas or mineral substance during the performance of the Work, except to the extent such loss or damage is caused by the Contractor Group's negligence or willful misconduct.

ii. EnCana hereby releases and agrees to defend, indemnify and hold the Contractor Group harmless from and against the loss or damage (1) to any geological formation, strata or oil or gas reservoir or minerals resource beneath the surface of the land or water, (2) for the loss of or damage to any hole(s) or well(s), and (3) for any impairment of any property rights or other interests in or to any oil, gas or mineral resources resulting from blowout, fire, cratering or any other cause, which may result during the performance of the Work, except to the extent such loss or damage is caused by the Contractor Group's negligence or willful misconduct.

iii. If equipment or instruments of the Contractor Group become lost in the well, EnCana shall either recover them without cost to the Contractor Group or pay the Contractor Group for the equipment or instruments (depreciated to date of loss); PROVIDED, HOWEVER, IF THE LOSS IS CAUSED BY THE NEGLIGENCE OF THE CONTRACTOR GROUP, ENCANA SHALL NOT BE LIABLE FOR THE LOSS AND THE CONTRACTOR GROUP SHALL RELEASE, DEFEND, INDEMNIFY AND HOLD HARMLESS THE ENCANA GROUP FROM AND AGAINST ANY LOSS, COSTS OR EXPENSE, INCLUDING COURT COSTS AND REASONABLE ATTORNEYS' FEES, SUFFERED OR INCURRED BY THE ENCANA GROUP THAT ARISES OR RESULTS THEREFROM.

f. In no event shall either party be liable to the other under this Agreement, for, and each party releases the other from and against, any indirect, special, incidental, punitive, exemplary or consequential damages, including, but not limited to, damages for loss of production, loss of revenue and profits, loss of business or business interruptions, loss of use of assets or facilities, related to the performance under this Agreement (collectively, "Losses"), WHETHER OR NOT SUCH LOSSES ARE THE RESULT IN WHOLE OR IN PART FROM THE SOLE, CONCURRENT, OR COMPARATIVE NEGLIGENCE OF ANY PERSON OR PARTY, INCLUDING THE INDEMNIFIED PARTY OR PARTIES, OR ANY DEFECT IN THE PREMISES, PRE-EXISTING CONDITIONS, PATENT OR LATENT, BREACH OF STATUTORY DUTY, STRICT LIABILITY OR ANY OTHER THEORY OF LEGAL LIABILITY, UNLESS SUCH LOSSES ARE CAUSED BY THE GROSS NEGLIGENCE, FRAUDULENT CONDUCT OR WILLFUL MISCONDUCT OF THE OTHER PARTY.

g. REDRESS UNDER THE INDEMNITY PROVISIONS SET FORTH IN THIS SECTION 10 SHALL BE THE EXCLUSIVE REMEDIES AVAILABLE TO THE PARTIES FOR THE MATTERS, CLAIMS, AND DAMAGES COVERED BY SUCH PROVISIONS.

11. Insurance. Contractor shall secure and maintain, and shall require its Subcontractors to secure and maintain, during the term of this Agreement, the insurance coverage set forth in Schedule I.

ALL LIABILITY COVERAGE (INCLUDING EMPLOYER'S LEGAL LIABILITY) CARRIED BY CONTRACTOR WITH RESPECT TO THE LIABILTIES ASSUMED BY CONTRACTOR HEREUNDER SHALL EXTEND TO AND PROTECT THE ENCANA GROUP TO THE FULL EXTENT AND AMOUNT OF SUCH COVERAGE, INCLUDING EXCESS OR UMBRELLA INSURANCES, AND SHALL BE PRIMARY TO, AND RECEIVE NO CONTRIBUTION FROM, ANY OTHER INSURANCE OR SELF-INSURANCE PROGRAMS MAINTAINED BY OR ON BEHALF OF OR BENEFITING THE ENCANA GROUP. THE LIMITS AND COVERAGES OF THE INSURANCE OBTAINED BY CONTRACTOR, EXCEPT TO THE EXTENT PROHIBITED OR REQUIRED BY LAW OR STATUTE, SHALL IN NO WAY LIMIT THE LIABILITIES OR OBLIGATIONS ASSUMED BY CONTRACTOR. ALL OF CONTRACTOR'S LIABILITY INSURANCE POLICIES SHALL NAME THE ENCANA GROUP AS AN ADDITIONAL INSURED AND CONTAIN A WAIVER ON THE PART OF THE INSURER, BY SUBROGATION OR OTHERWISE, OF ALL RIGHTS AGAINST THE ENCANA GROUP. This provision shall be independent of any obligations Contractor has under Section 10 hereof. Contractor's insurance carrier(s) will provide EnCana, as evidence that the required insurance coverage has been obtained, with a certificate of insurance reflecting the amount of any deductibles. Each of Contractor's insurance policies shall provide that it cannot be cancelled, materially altered, or allowed to lapse without at least thirty (30) days prior written notice by the insurance carrier to EnCana.

12. Independent Contractor. Contractor shall be an independent contractor with respect to the Work, and neither Contractor nor any Subcontractor, or their respective officers, employees or agents, shall be deemed the agent, representative, employee or servant of EnCana. Contractor and any Subcontractor shall have complete and sole control over their respective employees and the details of the Work performed and the methods by which the Work is accomplished, it being understood that EnCana is interested only in the results that Contractor obtains.

13. Compliance with EnCana Regulations and Policies; Applicable Laws. Contractor shall comply with and shall cause its Subcontractors and their respective employees to comply with all applicable EnCana rules and regulations (as revised from time to time) known to Contractor that relate to the safety and security of persons and property, protection of the environment. Contractor shall comply with, and shall cause its Subcontractors and their respective employees to comply with, all Federal, State and local laws, applicable to the Work, including, but not limited to, the Fair Labor Standards Act, OSHA, and all laws relating to disclosure and transportation of hazardous and toxic substances.

14. Default and Termination.

a. The provisions of Section 14.b. shall apply if any of the following events occur: (i) Contractor becomes insolvent, or insolvency, receivership or bankruptcy proceedings are commenced by or against Contractor; (ii) Contractor materially violates laws or ordinances applying to the Work or disregards instructions of EnCana; (iii) except as provided in Section 17, Contractor fails, neglects, refuses, or is unable to provide ample supervision, labor, materials or equipment to perform the Work at a rate and in a manner deemed sufficient by EnCana; (iv) Contractor allows any third party liens to be placed against the Work or the Site; or (v) Contractor defaults in its performance of any other material provision of this Agreement.

b. If an event described in Section 14.a. occurs, the following shall apply:

i. EnCana, without prejudice to any other right or remedy, may terminate this Agreement by giving notice of termination to Contractor, except that in the case of a default that may be corrected, Contractor shall be given a reasonable time to correct same.

ii. Contractor shall, if requested, withdraw from the Site and assign to EnCana such of Contractor's subcontracts as EnCana may request and shall remove the materials, equipment, tools, and instruments used by Contractor in the performance of the Work.

iii. EnCana shall have the right to finish the Work itself or with the assistance of third parties.

iv. EnCana shall be entitled to withhold the payment of any further sums due to Contractor until such Work is completed. EnCana and Contractor shall then determine by mutual agreement the amount, if any, of excess cost incurred by EnCana to complete the Work and the amount to which Contractor is entitled for its performance of the Work up to the date of such termination.

c. EnCana may, in its absolute discretion, terminate the Work without cause at any time by giving written notice of termination to Contractor pursuant to Section 16. If the Work is terminated by EnCana without cause, EnCana and Contractor shall have the following rights, obligations and duties:

i. EnCana shall assume and become liable for all obligations and commitments that Contractor may have previously in good faith undertaken or incurred in connection with the Work, and shall be entitled to all rights, setoffs, and benefits held by Contractor in connection with such commitments. Contractor, agrees to execute all instruments and take all steps required to vest such rights, setoffs and benefits in EnCana.

ii. EnCana shall pay Contractor, as compensation for the Work performed prior to said termination (i) all costs incurred by Contractor; (ii) the reasonable costs committed to by Contractor (such as costs which are not cancelable or recoverable) and demobilization costs, if applicable, and (iii) a mutually agreed to profit.

15. Title. Title to all Work completed or in the course of construction at the Site and to all materials, equipment and supplies which become a part of the Work or are used in the construction thereof, except Contractor's tools, equipment and supplies, shall pass to EnCana at such time as they are installed in their permanent positions and EnCana accepts care, custody and control of the Work pursuant to Section 5.b. Transfer of title shall not otherwise affect the parties' rights under this Agreement.

16. Term. This Agreement shall be for a term of one (1) year from the date hereof and from year-to-year thereafter until terminated. Either party may terminate this Agreement at any time, with or without cause, on not less than thirty (30) days prior written notice of such termination. Any such termination shall not affect any rights or obligations which have accrued under this Agreement.

17. Force Majeure. Any delay in or failure to perform by a party, other than the payment of money, shall not constitute a default that exposes it to liability for breach if and to the extent the delay or failure to perform is caused by an occurrence beyond the reasonable control of the party, including, but not limited to, an act of God or the public enemy; expropriation or confiscation of facilities; compliance with any order or requirement or any governmental authority; act of war, rebellion or sabotage or damage resulting therefrom; fire, flood, explosion or accident; riots or strikes or other concerted acts of workmen; inability after diligent effort to obtain necessary licenses or permits; or any other cause, whether or not of the same class or kind as those specifically above named, which is not within the control of the party and which, by the exercise of reasonable diligence, the party is unable to prevent or remedy. In the event of force majeure, the party claiming force majeure shall furnish the other party with written notice or by telephone immediately confirmed in writing, setting forth the full particulars of the force majeure claimed, as soon as possible after the occurrence of the force majeure, and the obligations of that party, so far as they are affected by such force majeure, shall be suspended during the continuance of any inability so caused, but for no longer. The party relying upon such force majeure shall use due diligence and all reasonable efforts (including reasonable expenditure of money) to overcome the cause of force majeure. If a force majeure event exceeds thirty (30) days, either party may cancel the Work under the applicable Work Order.

18. Rebates. Neither Contractor nor any of its Subcontractors shall pay any commission, rebate, fee or other remuneration to any employee, representative or agent of EnCana, or each other, in connection with the Work.

19. Assignments and Subcontractors. Neither party may assign or subcontract its rights or duties under this Agreement, except to an Affiliate, without the prior consent of the other party, which consent shall not be unreasonably withheld, except that subcontracts by Contractor for services valued at less than five hundred dollars shall not require EnCana approval. An assignment, delegation or subcontract in violation of this Section 19 shall be void. Consent to assign given by a party shall not relieve the other party of responsibility for performance of its obligations under this Agreement.

20. Waiver. The waiver by either party of a breach or default by the other party shall not be deemed a waiver of any different or later breach.

21. Conflicts. In the event of a conflict, this Agreement controls over any Work Order, or the terms and conditions in Contractor's or EnCana's purchase orders, field tickets, invoices, statements, or any other type of agreement or document used by either party in the normal course of business, whether oral or written, signed or unsigned.

22. Applicable Law. The provisions of this Agreement shall be governed by the laws of the State of Colorado, without giving effect to any conflict of law provisions. Any judicial proceeding brought hereunder shall be brought exclusively in the District Court for the City and County of Denver, Colorado. Each party hereby consents to the jurisdiction of such court and waives any defense or objection to such jurisdiction and/or venue.

23. Notices. All notices and other communications required by this Agreement shall be in writing and deemed duly given four business days after being sent by registered or certified mail, return receipt requested, to the address provided herein. Notice by personal delivery, ordinary mail, facsimile, or electronic mail, shall be deemed given upon actual receipt by such other party. A party may change the address for notices by giving the other party notice of such change in the manner set forth herein.

24. Entire Agreement. This Agreement and any Work Order between EnCana and Contractor constitute the entire agreement between the parties on the subject matter referred to therein and supersede all prior negotiations, agreements and correspondence. This Agreement may be changed only by a written instrument signed by the parties. Neither execution of this Agreement, nor anything contained herein, shall obligate EnCana to order Work from Contractor, nor obligate Contractor to accept Work from EnCana.

25. Severability. If any provision (or portion thereof) of this Agreement shall be declared invalid, illegal or unenforceable, the remaining provisions shall not be affected thereby, and this Agreement shall be construed as if such invalid, illegal or unenforceable provision (or portion thereof) had never been contained herein.

26. Arbitration. Any disputes between the parties arising out of or in connection with this Agreement shall be fully and finally settled by arbitration, before one arbitrator, in accordance with the most current CPR Institute for Dispute Resolution rules. Such arbitration shall be conducted in Denver, Colorado. Each party shall pay its own costs and attorneys fees.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed by their duly authorized representatives as of the date first above written.

CONTRACTOR:
Centech Inc.

Signature________________________
By: Neal Miller

Its: Owner/President

Address:	920 Lakeview Lane Casper, WY 82604
Phone	307-267-4304
Fax:	n/a

ENCANA OIL & GAS (USA) INC.

Signature:______________________________

By: _______________________________

Its: ________ Vice President ___________

Address: 370 17th Street, Suite 1700
Denver, CO 80202
303-623-2300

EXHIBIT A

Master Service Agreement Dated _____

WORK ORDER

EnCana Oil & Gas (USA) Inc.
370 17th Street, Suite 1700
Denver, Colorado 80202

EFFECTIVE DATE _____ WORK ORDER NUMBER: _____

CONTRACTOR **Company Name**: **Address**: **Contact**: **Office:** **Fax:** **Email**:	**THIS WORK ORDER IS SUBJECT TO THE TERMS AND CONDITIONS OF AN EXISTING MASTER SERVICE AGREEMENT:** THE PARTIES AGREE THAT THIS WORK ORDER NUMBER _____ SHALL BE INCORPORATED INTO AND MADE A PART OF THAT CERTAIN MASTER SERVICE AGREEMENT BETWEEN THE PARTIES, DATED _____. THE PARTIES FURTHER AGREE THAT THE TERMS AND CONDITIONS OF SAID MASTER SERVICE AGREEMENT SHALL CONTROL THE WORK AUTHORIZED HEREUNDER. THE AGREEMENT TERMS CONTAINED HEREIN, TOGETHER WITH THE MASTER SERVICE AGREEMENT AND ANY ATTACHMENTS THERETO SHALL FORM THE PROVISIONS OF THE ENTIRE AGREEMENT.

SCOPE OF WORK AND TERMS AND CONDITIONS OF WORK ORDER

A. SCOPE OF WORK: (services & supply)

Contractor shall provide all labor, supervision, equipment, transportation, and other incidentals necessary to provide , hereinafter referred to as "Work", on various oil and gas properties operated by EnCana Oil & Gas (USA) Inc.

B. COMPENSATION:

Compensation for Work performed under this Work Order shall be as follows:
<u>(describe full and complete compensation)</u>

CONTRACTOR'S AUTHORIZED REPRESENTATIVE SHALL EXECUTE BOTH ORIGINALS OF THIS WORK ORDER, AND RETURN TO:

<u>Eddie Carpenter</u>
EnCana Oil and Gas (USA) Inc.
370 17th Street, Suite 1700
Denver, CO 80202

Centech Inc.	**EnCana Oil & Gas (USA) Inc.**
Signature: ______________________	Signature: ______________________
By: ______________________	By: ______________________
Title: ______________________	Title: ______________________
Date: ____/____/____	Date: ____/____/____

SCHEDULE I
INSURANCE REQUIREMENTS

In accordance with the Agreement, Contractor shall, at its sole cost and expense, obtain and continuously carry during the Term the following insurance coverage, with reputable and reliable insurers acceptable to EnCana:

Comprehensive General Liability
Comprehensive General Liability Insurance INCLUDING CONTRACTUAL LIABILITY, with minimum limits of liability for injury, death, or property damage of *two million dollars ($2,000,000.00) combined single limit per occurrence.

OPTIONAL, CHOOSE AS APPLICABLE:

Automobile (required where Contractor operates a motor vehicle in the course of performing the Work)

☒ Automobile Liability Insurance covering owned, hired, and non-owned vehicles used by Contractor, with minimum limits of liability for injury, death, or property damage of *two million dollars ($2,000,000.00) combined single limit per occurrence.

☐ Automobile Liability Insurance covering owned, hired, and non-owned vehicles used by Contractor, with minimum limits of liability for injury, death, or property damage of one million dollars ($1,000,000.00) combined single limit per occurrence.

Employees (required for Master Service Agreement and Service Agreement)

☒ Worker's Compensation Insurance
Worker's Compensation Insurance covering Contractor and all of Contractor's personnel engaged in performing the Work in accordance with the statutory requirements of State laws as well as Federal laws, if applicable.

OR

Employers' Liability Insurance
Employers' Liability Insurance covering Contractor and all of Contractor's personnel engaged in performing the Work with limits of not less than one million dollars ($1,000,000.00) per occurrence.

*Contractor may include umbrella coverage to reach the minimum limits.

SECTION FIVE
APPLICANT'S RESOURCES

SECTION FIVE – APPLICANT'S RESOURCES

TO BE PROVIDED BY THE APPLICANT

1. **ATTACHMENT NO. 1 – COMPANY'S STAFF**
2. **ATTACHMENT NO. 2 – DETAILED RESUMES**
3. **ATTACHMENT NO. 3 – EQUIPMENT DETAILS**
4. **ATTACHMENT NO. 4 – AUDITED FINANCIAL STATEMENT**
5. **ATTACHMENT NO. 5 – OTHER FINANCIAL DATA**

SECTION FIVE – APPLICANT'S RESOURCES

1. PERSONNEL EXPERTISE AND RESOURCES

1.1 The present number of permanent employees on Applicant's payroll ___10___.

1.2 The Applicant shall provide (as **Attachment No.1** to Section Five) the staffing levels of its company with a breakdown as per the following:

1.2.1 Personnel

The following information for each personnel shall be provided in a tabulated form:

- Qualification (Academic)
- Certifications
- Experience
- Full time or part time
- Membership of Professional Bodies / Accolades

1.3 Attach (As **Attachment No.2** to Section Five) detailed resumes of ten personnel in each job category currently on the Applicant's direct payroll:

1.4 Does the Applicant possess any Codes, Standards, Recommended Practices and Guidelines related to waste management? Specify documents reference number, title and edition.

(SEE CONTINUATION 1.4 – SECTION FIVE)

1.5 List equipment and equipment capacities (As **Attachment No.3** to Section Five) the Applicant utilizes in the management of all categories of wastes?

(SEE Attachment No.3 –SECTION FIVE)

1.6 What technical resources do the Applicant poses to carryout waste management works?

SECTION FIVE- CONTINUATIONS

CONTINUATION #1.4: Does the Applicant possess any Codes, Standards, Recommended Practices and Guidelines related to waste management Specify documents reference number, title and edition.

(1) W.J. Parkinson, G.F. Luger, R.E. Bretz, and J.J. Osowski, "An Expert System for Screening Enhanced Oil Recovery Methods", Paper presented at The 1990 Summer National Meeting of the American Institute of Chemical Engineers, San Diego, CA, August 19-22, 1990.

(2) C.E. Polston, R.E. Bretz, R.E. Williams, and W.J. Parkinson, "Centrifuge Technology for Disposal Pit Closure", Paper presented at The Fourth Annual Environmental, Safety, and Health Conference and Exhibition for the Oil, Gas, and Petrochemical Industries, Houston, TX, January 26-28, 1993.

(3) W.J. Parkinson, R.E. Bretz, R.E. Williams, C.E. Polston, and Neal Miller, "Centrifuge Technology for Minimizing Petroleum Waste", International Journal of Environmentally Conscious Design & Manufacturing", Vol. 2, No. 1, 67-79 (1993).

(4) W.J. Parkinson, and K.H. Duerre, "A Comparison of Crisp and Fuzzy Logic Methods for Screening Enhanced Oil Recovery Techniques", Chapter 9 in Fuzzy Logic and Control, Software and Hardware Applications, Eds. M. Jamshidi, N. Vadiee, and T.J. Ross, pp. 181-216, Prentice Hall, (1993).

(5) R. Steele, W.J. Parkinson, A. Graham, and N. Tetlow, "Oil Sludge Recovery Using a Continuous Three-Phase Centrifuge", Paper presented at the Annual National Meeting of the American Institute of Chemical Engineers, St. Louis, MO, (November 1993).

(6) W.J. Parkinson, G.F. Luger, R.E. Bretz, and J. Osowski, "Using an Expert System to Explore Enhanced Oil Recovery Methods", Computers and Electrical Engineering, Vol. 20, No. 2, 181-197 (1994).

(7) C. Polston, R.E. Bretz, W.J. Parkinson, A.L. Graham, and R.D. Steele, "Three-Phase Centrifuge to Minimize Waste from Production Tank Bottoms and Sludges: An Economic Analysis", Paper presented at the Society of Petroleum Engineers SPE/EPA Environmental Conference '95, Houston, TX, (March 1995).

(8) W.J. Parkinson, R.E. Smith, and N. Miller, "Control of a Three-Phase Oil Field Centrifuge, Using Fuzzy Logic", Paper presented at the Second Biennial Tri-Laboratory Engineering Conference on Modeling and Simulation, Santa Fe, NM, November 12-14, 1997.

(9) W.J. Parkinson, R.E. Smith, and N. Miller, "Fuzzy Control System for an Oil Field Centrifuge", (LA-UR-00-2603) Progress Report presented for the DOE Petroleum Technology Office Contractors Review Meeting, Denver, CO, June 26-29, 2000.

(10) W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, T.J. Ross, N. Miller, "Fuzzy SPC Filter for a Feed-Forward Control System for a Three-Phase Oil Field Centrifuge", (LA-UR-01-6410, LA-UR-02-0357, LA-UR-02-3410) Paper presented at the World Automation Congress, Orlando, FL, June 2002.

(11) W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, T.J. Ross, M. Jamshidi, N. Miller , "Fuzzy Feed-Forward/Feedback Control System for a Three-Phase Oil Field Centrifuge", (LA-UR-02-1724, LA-UR-02-3225, LA-UR-02-4150), Sixth Annual Conference on Engineering Design & Automation, Maui, HI, August 2002.

Continuation# 2c : In view of Financial Data 2c(i) thur 2c(v) see The Submitted Parent Company Guarantee Submitted herewith as Appendix.

2. APPLICANT'S FINANCIAL RESOURCES AND STATEMENT

(All figures must be given in thousand US Dollars and all the reports must be in English.)

The Applicant must provide all of the attachments and information called for and in the format as indicated.

2a) Please state whether your organization is profit earning and distributing, self-financing or otherwise financed.

2b) Please provide details of financial status like paid-up capital, latest financial reports, interest expenses, interest income, other income and the like.

2c) Please provide audited statements of your company for the latest three (3) years which should be include the following as a minimum:

- i) Auditor Report.
- ii) Balance Sheet Statement.
- iii) Income Statement / Profit and Loss Statement.
- iv) Cash Flow statements.
- v) Notes of Accounts.

Notes: I. All Financial Statements, Auditor Report, Balance Sheets, Income Statements, /Profit and Loss accounts, Statements of Cash Flows & Notes of Accounts shall be certified by a qualified auditing firm and prepared according to **International Financial Reporting standards (IFRS), OR Generally Accepted Accounting Principles (GAAP), <u>in English Language.</u>** Agencies or Organizations who fail to comply with the required financial information will not be considered.

II. If the financial statements are not expressed in US$, then the Applicant shall provide the rate per 1 US$ for the statements provided during the evaluated years.

For Section 2c) above, see continuation# 2c section Five.

Signature: Ernest W. Alexander

Name: Ernest W. Alexander

Name and Title of Authorized Signatory: Ernest W. Alexander-Managing Partner

Applicant's Company Name: Centech International LLC

Applicant's Company Stamp:

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3443 Burr Road, Casper, Wyoming 82601

SECTION FIVE

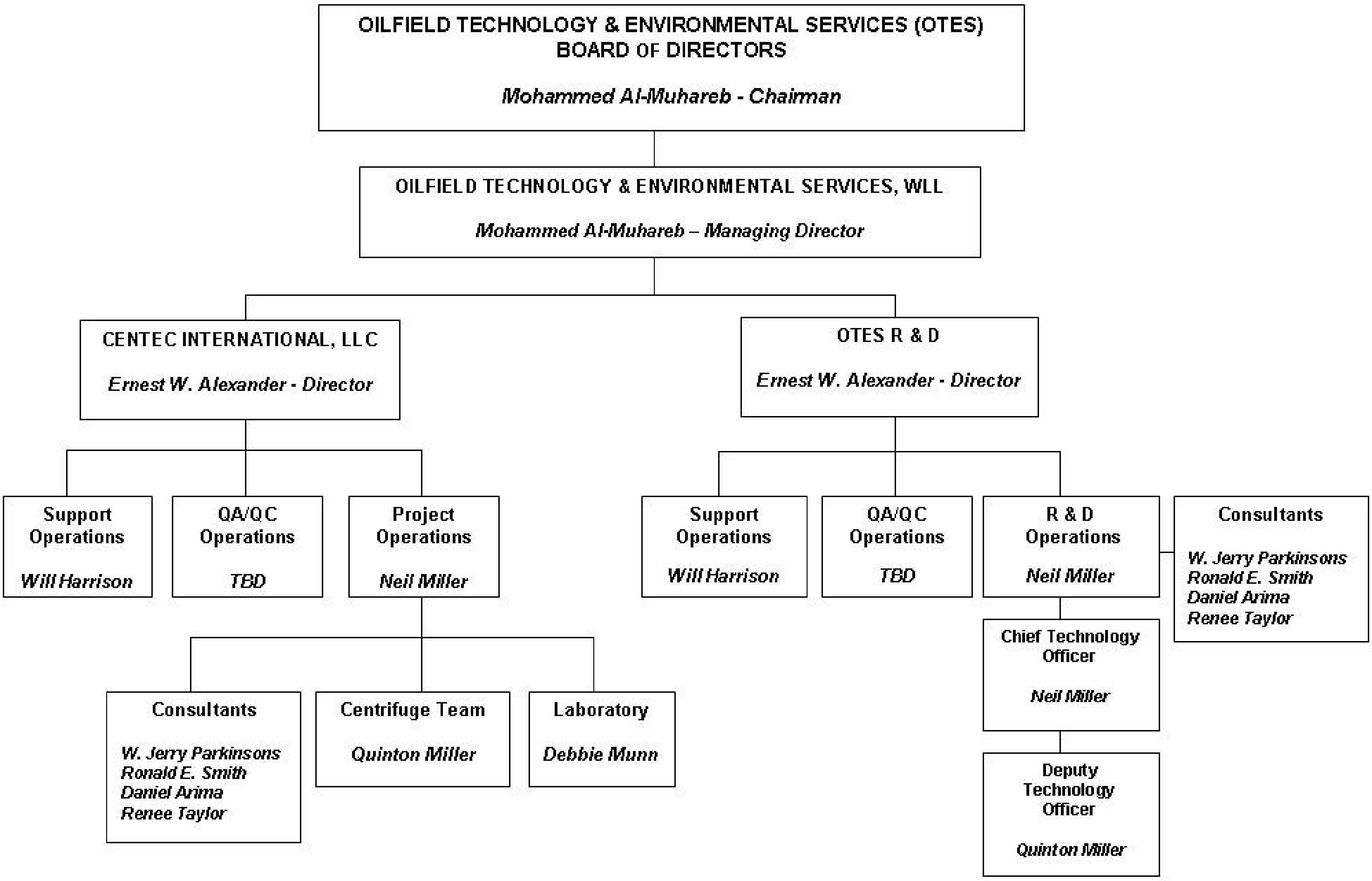
ATTACHMENTS NO. 1 - 5

ATTACHMENT NO. 1 – COMPANY'S STAFF
ATTACHMENT NO. 2 – DETAILED RESUMES
ATTACHMENT NO. 3 – EQUIPMENT DETAILS
ATTACHMENT NO. 4 – AUDITED FINANCIAL STATEMENT
ATTACHMENT NO. 5 – OTHER FINANCIAL DATA

SECTION FIVE

ATTACHMENT NO. 1
CENTECH STAFFING

CENTECH INTERNATIONAL
STAFFING STRUCTURE



SECTION FIVE

ATTACHMENT NO. 2
RESUMES

Ernest W. Alexander, Esq.

Attorney-At-Law

Ali Ali Salem Street
Abdullah Taki Building, 1st and 2nd floor
P.O. Box 5750 Safat, 13058 – Kuwait
Telephone: [965] 242 5163/4/5
Dir: [965] 240 1252
Fax:[965] 240 1251
Email: alotaibi_partners@yahoo.com

Commercial Activities

OTES **Oil Field Technologies & Environmental Services** WLL : Remediation of Oily Sludge Pits & Effluent Water
Director & Advisor to the Board

Centech International LLC: Remediation of Oily Sludge Pits & Effluent Water
Manager

OTES **OTES R & D** LLC: Development and Commercialization of Intellectual Property
Manager

OBS Associates LLC Consulting and Miscellaneous Services to Commercial Ventures

Admitted to the practice of Law: Supreme Court of Pennsylvania; The United States Courts of Appeals for The District of Columbia, Third, & Seventh Circuits.

Employment History

May 1992 - Present

AHMAD GH. AL-OTAIBI & PARTNERS, Partner

- General representation of corporate clients and high net worth individuals involving local and international commercial disputes; Corporate & financial services; joint ventures; purchase, sales, agency and labor contracts; construction claims litigation and arbitration and general advise on such matters as structuring of transactions, international tax and management of international litigation and arbitration. Management responsibility for international legal work.

1991 – 1992

MINTZ LEVIN COHEN FERRIS GLOVSKY & POPEO, P.C. , Partner

- General representation of corporate and individual clients for International Group with in the firm; Particular specialty in Middle East matters in general and Kuwaiti reconstruction specifically. In affiliation with Al-Otaibi & Partners spent two weeks per month as resident in Kuwait Office.

1985 – 1991

AHMAD GH. AL-OTAIBI & PARTNERS, Partner

- General representation of corporate clients and high net worth individuals involving local and international commercial disputes; corporate and financial services; joint ventures; purchase, sales, agency and labor contracts; construction claims litigation and arbitration and general advise on such matters as structuring of transactions, international tax and management of international litigation and arbitration. Management responsibility for international legal work.

1984 – 1985

OTAIBI & TUHAIH, Senior Associate

- General representation of corporate clients and high net worth individuals involving local and international commercial disputes; corporate and financial services; joint ventures; purchase, sales, agency and labor contracts; construction claims litigation and arbitration and general advise on such matters as structuring of transactions, international tax and management of international litigation and arbitration. Management responsibility for international legal work.

1982 – 1984

ALI AL-RADWAN & PARTNERS (THE LAW BUREAU), Associate Attorney

- General representation of corporate and high net worth individual clients involving local and international commercial disputes; corporate and financial services; joint ventures; purchase, sales, agency and labor contracts; construction claims litigation and arbitration and general advise on such matters as structuring of transactions, international tax and management of international litigation and arbitration.

1980 – 1982

COMMODITY FUTURES TRADING COMMISSION, General attorney (Finance), Washington, D.C.

- Office Of The General Counsel ("CFTC") General legal representation of the CFTC and it's Divisions & employees; Regulatory Rule Reviews, Drafting of Pleadings including memoranda & motions for commodity litigation and commodity broker bankruptcies. Responding to queries from public and Freedom of Information Act requests. General legal research.

Education

1977-80 ***BOSTON COLLEGE LAW SCHOOL***

- Newton, Massachusetts Juris Doctor, May 1980 Activities- Frederick Douglass National Moot Court Team (1979 Northeast Regional Winners & Regional Best Brief; National Semi-Finalist and National Best Brief) Academic Emphasis : General corporate and taxation including International taxation

1976-77 ***BOSTON UNIVERSITY GRADUATE SCHOOL OF SOCIAL WORK***

- Boston, Massachusetts Candidate for joint M.S.W.-M.A. degrees in Social Work and Afro American History, respectively. Academic Emphasis : Administration & Planning (12 Month of 18 consecutive month program completed.)

1972-76 ***PROVIDENCE COLLEGE***

- Providence, Rhode Island Bachelor of Arts, Social Work, May 1976

Civic Activities

- ***AMERICAN SCHOOL OF KUWAIT***

  10 years Board Member, including term as Vice Chairman

- ***AMERICAN BUSINESS COUNCIL***

  former Steering Committee Member; former Executive Committee Member

My duties included

Tear down, cleaning , and rebuilding of diesel fuel injection pumps and diesel fuel injectors

Tear down, cleaning, and rebuilding of turbochargers of all makes and models

I did general maintenance, troubleshooting and parts replacement on all makes and models of cars and trucks.

I also built special tooling and did machining and welding.

Hobbies

Gun Smithing, target shooting, working on old cars and trucks.

References

Reference available upon request

955 7 Mile Rd.
Casper, Wyoming 82604
U.S.A.

307-259-2140
QJM15c@Aol.com

Quinton J. Miller

Education

Graduated from Natrona county High school 2003

Graduated from Casper college Diesel Power program 2004

2 years of Welding and machine shop classes at Casper college 2005-2006

Graduated from Sage Technical truck driver training with full class A CDL 2005

Work experience

June 2006- present Centech Inc. Casper, Wyoming
I have worked for Centech on and off for the last 10+ years, working in the summers when I wasn't in school. The last three years I have worked full time.

My duties have include

Operating and performing preventative Maintenance on three-phase centrifuge.

Tear down cleaning and overhaul of three phase centrifuge.

Tear down, cleaning, and element replacement of specific heating equipment.

I also take oil & water samples and run grind outs or PH test.

I also weld and do some machining, and have been involved in redesign of equipment and on R&D project for Centech

Operating Equipment such as varyies tractors, gen sets, semi trucks ect.

March 2006 AAA Hotshoters Casper, Wyoming

I worked for AAA Hotshoters for 4 month Part time.

My duties included

Hauling Equipment parts to and from Drilling rigs, using a one ton pick and 32 ft. goose neck trailer.

I have experience securing out of the ordinary Loads for transport to and from location.

May 2005 Turbo & Diesel service Casper, Wyoming

I worked for Turbo & Diesel for two years after I received my diesel certificate from Casper college

NEAL MILLER

920 Lakeview Lane Casper , Wyo 82604
307-473-2047

SUMMARY OF QUALIFIATIONS

Thirty Five years oil field experience from drilling and production to pipeline tank farm and refining. Trained in blowout and well control / service, fab, modify, build, design, test, troubleshoot all solids control equipment for drilling mud and De-watering . Twenty Two years experience Three Phase Centrifuge. Two patents

WORK OF EXPERIENCE

1974 - 1980 Dresser Swaco Casper / Rocksprings Wyo Field Service / Rocky Mountain area Tech Service Blowout, Detection & Control, Solids Control Equipment, Two Phase Centrifuge

1980 - 1983 Baker Companies Milchem Drilling Controls / Totco Solids Control Casper based Field Service / Area Service Manger / US Operations Tech Service / Troubleshooting

1984 - 1985 Wadeco Solids Control Casper Area Manager / Field Service / Rocky Mountain Area Tech Service & Troubleshooting

1985 - 1986 Ensearch Corp. Oiltools USA. Casper Contract R & D / 3 Phase Centrifuge (Oil Field Sludge)

1986 - 2007 Centech Inc. Casper Corp. Pres. Run Operations R&D, Manufacturing, Sales,

2007 - Present OTES Centech International Maintain US Operations Develop Overseas Projects

EDUCATION

1975 Graduate Natrona County High School

EXTRACURRICULAR ACTIVITIES

Dirt track racing , work on old cars and trucks, bale hay, shooting

REFERENCES

Chet Warlick
Ernest Alexander

NABEEL ALEXANDER

28 Arden Street, Allston, MA, 02134 • (617) 909-3866 • alexanna@bc.edu

Education

Boston College Law School Newton, MA
Candidate for *Juris Doctor* May 2008
GPA: 3.29
Activities: Law & Religion Program (Founding Member)
Negotiation Competition
Client Counseling Competition
Black Law Students Association

Boston College Graduate School of Arts & Sciences Chestnut Hill, MA
Candidate for Master's of Art Degree, Philosophy May 2008
GPA: 3.85

Knox College Galesburg, IL
Bachelor of Arts in Philosophy, June 2003
Honors: Ronald E. McNair Fellow: Completed two research projects, *"Neighborhood Networking: Successfully Bridging the Digital Divide through Communities and Technology,"* published in Knox College McNair Journal 2001, and *"Hope, Terror, and Roots,"* published in Knox College McNair Journal 2002
Activities: Teaching Assistant, Philosophy and Education departments
Student Senate
Model United Nations
Intramural Soccer and Softball
Musical Performances

Professional Experience

Duane Morris LLP, Philadelphia, PA *Summer 2007*
Summer Associate

- Performed writing and research in litigation and transactional assignments relating to property law, tort law, ethics, administrative law and securities.
- Drafted pleadings for withdrawal of counsel and IT presentation.
- Performed Statutory research and analysis of technology and property law.

Al-Otaibi & Partners, Kuwait City, Kuwait *Summer 2005-2006*
Summer Intern

- Performed writing and research in matters relating to international child custody actions, contract negotiations, fraud based on attorney impersonation, wrongful termination, debt collection, breach of Contract claims, drafting settlement and release agreements, U.S. Immigration filing, legal representation agreements, and international property dispute resolution.
- Interviewed clients, and assisted them in completing paperwork and verifying facts related to the matters listed above.
- Drafted license distribution agreement between manufacturer and distributor.
- Corresponded with California Secretary of State, Washington Secretary of State, California and Massachusetts Bar Associations, Massachusetts Board of Bar Overseers, Alabama Dept. Of Human Resources, U.S. Embassy (Kuwait) and private companies in relation to cases.

Liquid Memory LLC *October 2000-Present*
CEO/Founder

- Founder of a small web-based company offering services in web-hosting, internet security, network solutions, special order technological hardware, website and logo design, anti-virus protection, data and system recovery for individual and corporate clientele.
- Oversee marketing/advertising, customer relations, legal affairs, and technology management.

WILBURN J. HARRISON
CSA / CISO
APO AE 09330

OBJECTIVE

I am seeking a challenging position in the areas of operations, logistics, supply, or transportation, with an opportunity for advancement.

EXPERIENCE

Nov. 99 – Present **Contract Support Associates, LTD, Camp Doha, Kuwait**
Senior Exercise Planner
Responsible for planning and coordination of exercises, contingencies, equipment support requirements, and logistical support for rotational units. Plans and coordinates equipment issues and turn-ins. Coordinated issues, boat downloads, and turn-ins, and other logistical requirements for contingency operations in support of OEF / OIF. Develops agendas and schedules for planning conferences and conducts process reviews. Coordinates supplemental issues, Transportation requirements, and analyze equipment requirement data for the CSSC-K Contract. Plan and coordinate equipment research as requested by Contracting Representatives. Plan and coordinate the establishment of Training Equipment Set.

Sept. 94-Oct 99 **ITT Systems Support Group, Camp Doha Kuwait.**
Senior Exercise Planner
Responsible for the planning and coordination of exercise, contingencies, equipment support requirements, and logistics support for rotational exercise units. Plans and coordinates unit requirements with ARCENT-Kuwait Staff elements, ITT Department Managers, and the exercise units. Performed duties and the ITT WARDEN and the Deputy Operations Manager.

March 93 – Sept 94 **DynCorp International Services Ltd., Camp Doha Kuwait.**
Logistics/Exercise/Contingency Coordinator and Planner
Conducts exercise, contingency and logistics coordination with rotational units, DynCorp, and the ARTAS-K (ASG-K) Staff. Responsible for the initial planning and staffing of exercise support requirements. Coordinates contingency planning and requirements for DynCorp to include Range Target Requirements, services, POL requirements, Classes of Supply requirements, and the issue and turn in process. Coordinates fielding plans, site visits, and tours. Responsible for coordinating tasking requirements, internal and external. Additionally Performed duty as DynCorp WARDEN to the U. S. Embassy.

1991 – 1992 **United States Armor Center & School, Fort Know, KY 40121**
Instructor/Trainer Developer
Instructs the Senior Officer Logistics management Course, Pre-Command Course, Battalion Officers Motor Course, and the Armor Officer’s Advanced and Basic Courses. Responsible for developing instructional

material in support of the Maintenance Management Program, Material Condition Status Report, Unit Movement, Logistics Over the Shore

Operations, the Army Supply System, Unit Level Logistics System, and Troop Support Equipment.

1989 – 1991 **101st Airborne Division (AA), Fort Campbell, KY 42223**
Company Commander
Commander for Headquarters and Headquarters Company, Division Support Command. Responsible for health and welfare of over 250 assigned soldiers. Maintained an Equipment Readiness Rate of over 95% Deployed unit to Southwest Asia, participated in Desert Shield and Desert Storm.

1986 – 1989 **101st Airborne Division (AA), Fort Campbell, KY 42223**
Support Operations / Mechanical Maintenance
Directed and managed the mechanical, missile, communications, and electronics maintenance missions for the Division. Directed the fielding of over 1600 High Mobility Multipurpose Wheel Vehicles to Fort Campbell. As Support Operations Officer, responsible for the planning and coordination of logistics for Battalion, Brigade, Division, and Corps level exercises and deployments.

1984 – 1986 **227th Maintenance Battalion, APO SF, CA 96301 (Korea)**
Supply Officer
Provide Logistical Support to over 150 Non-divisional units covering a 3000-mile area. Responsible for Classes I-IV, VII, Self Service Center, and the Central Issue Facility. Also responsible for coordinating exercise support and equipment issue.

EDUCATION

Texas College, Tyler, TX
BS, August 1977 – May 1981
Major: Physical Education
Minor: Biology
GPA: 3.33
Teacher Certification (TX)
Security Clearance (Current)

Ordinance Officer Basic Course
Direct SPT Unit Standard Supply System
Ordnance Officer Advance Course
Air Assault School
Combined Arms Service & Staff School
Senior Officer Logistics Course
Instructor Training Course
Instructor Training Course ULLS
Technical Trans of HAZMAT Course

REFERENCES

Available upon request

Resume
William Jerry Parkinson
406 Bryce Ave.
Los Alamos, NM 87544

Education:

B.S., Chemical Engineering, University of Utah, 1964
M.S., Chemical Engineering, University of Utah, 1967
Ph.D., Chemical Engineering, University of Southern California, 1974
M.S., Computer Science, University of New Mexico, 1985
Ph.D. Electrical Engineering, University of New Mexico, 2001

Work Experience:

Fluor Corporation, Process Engineer/Computer Engineer, 1967-1972
Work included: process design, flow sheet analysis, thermodynamics –chemical and vapor-equilibrium and energy balances, computer programming.

Fractionation Research, Research Engineer, 1973-1974 (part time position, while attending USC.) Work included distillation and vapor-liquid equilibrium thermodynamics.

Columbia Gas Research, Research Engineer, 1974-1977, Work included coal gasification, chemical reactor design and chemical equilibrium calculations.

Los Alamos National Laboratory, Technical Staff Member/Team Leader, 1977-2006 (Retired in 2004- until 2006 part time Laboratory Associate.) Work included process design and analysis, thermodynamic analysis and intelligent process control. Team leader for the Chemical Process Development Team in the Applied Engineering Technology Group.

PM Tech Inc, Consultant to Los Alamos National Laboratory, 2006-2007, Work was essentially the same as described above, without management responsibility. Retired again in 2007.

William Jerry Parkinson
Publication List

1. W.J. Parkinson and Noel de Nevers, "Partial Molal Volume of Carbon Dioxide in Water Solutions", I. and E. C. Fundamentals 8, 704, November 1969.

2. R.J. Jiacoletti, J.W. Barnes, W.J. Parkinson, and K.H. Duerre, "A Comparison of Several Surface Oil Shale Processes Combined With a Modified In-Situ Oil Shale Process" Paper presented at 88th National Meeting of the American Institute of Chemical Engineers, Philadelphia, PA, (June 1980).

3. W.J. Parkinson, "Shale-Oil Denitrification by Acid Treating", Los Alamos National Laboratory report LA-9410-MS (June 1982).

4. W.J. Parkinson and T.J. Merson, "Cost Analysis of the Carbon Monoxide Steam Process", Los Alamos National Laboratory report LA-9463-MS (August 1982).

5. W.J. Parkinson and J.G. Sanderson, "Nonlinear Optimization Applied to Chemical Equilibrium Problems", Los Alamos National Laboratory report LA-9670-MS (March 1983).

6. E.J. Peterson, W.D. Spall, P. Wagner, L.M. Holland, M.I. Tillery, W.J. Parkinson, and G.F. Strniste, "An Approach to Oil Shale Health and Environmental Research: A Concept Paper", Los Alamos National Laboratory report LA-9805 UC-41 and UC-91 (November 1983).

7. T.T. Phillips and W.J. Parkinson, "Modeling the HYTORT Process for Eastern Oil Shale Using the CRAY-1 ASPEN Flow Sheet Simulator", Paper presented at the Systems Simulation Symposium of Fossil Fuel Conversion Processes, Morgantown WV, (December 1983).

8. W.J. Parkinson, T.T. Phillips, and J.W. Barnes, "A Comparison of Five Process Concepts for Using Eastern Oil Shale", Paper presented at the National Meeting of The American Chemical Society, St. Louis Missouri, April 8-13, 1984. (See Preprints Vol. 29, No. 1, pp. 185-193) Also in Los Alamos National Laboratory report LA-10106-MS (June 1984).

9. W.J. Parkinson, "The Economics of Oil Shale Conversion", Tutorial presented at the Oil Shale Symposium of The National Meeting of the American Chemical Society, St. Louis Missouri, April 8-13, 1984. Also in Los Alamos National Laboratory report LA-UR 84-1176.

10. W.J. Parkinson and J.G. Sanderson "Solving Chemical Equilibrium Problems Using Nonlinear Optimization", Los Alamos National Laboratory report LA-10116-MS (June 1984).

11. W.J. Parkinson, T.T. Phillips, and J.W. Barnes, "Five Process Concepts for Using Eastern Oil Shale: An Economic Comparison", Energy, Vol. 9, No. 5, (Fall 1984).

12. T.T. Phillips, K.A. Odell, W.J. Parkinson, R.C. Rex, and J.C. Janka, "ASPEN Simulation of Commercial HYTORT Reactor Configurations." 1984 Eastern Oil Shale Symposium (November 1984) (See Proceedings pp. 321-330).

13. W.J. Parkinson and D.E. Christiansen "An Experimental Study of the Effect of Reactant Gas Mixing on Silicon Carbide Whisker Growth", Los Alamos National Laboratory report LA-10658-MS (February 1986).

14. W.J. Parkinson, E.J. Peterson, T.T. Phillips, W.D. Spall, and R. Bachta "Yield Optimization of an Experimental Retort Using the ASPEN Computer Code", Paper presented at The 1986 Annual Meeting of the American Institute of Chemical Engineers, Miami Beach, FL, November 2-7, 1986.

15. W.J. Parkinson, "Using PC-Based Expert System Shells to Develop an Expert Assistant that can Help Plant Designers Choose the Proper Thermodynamic Package for Use with the ASPEN Computer Code.", Paper presented at The 8th Biennial CUBE Symposium, Albuquerque, NM, November 16-18, 1988.

16. W.J. Parkinson, G.F. Luger, and R.E. Bretz, "Using PC-Based Shells to Write an Expert Assistant for Use with the ASPEN Computer Code," Paper presented at the 1989 Annual meeting for the American Institute of Chemical Engineers, Houston, Texas, April 2-6, 1989. Also in Department of Computer Science, College of Engineering, University of New Mexico Tech Report No. CS89-4.

17. E.J. Peterson, W.J. Parkinson, L.E. Wangen, K.C. Ott, K.H. Hargis, and T.W. Whaley, "Development of Inherently Safe and Environmentally Acceptable Intelligent Processing Technologies for HTS Materials", Paper presented at the Society of Manufacturing Engineers Conference -- Superconductivity: The Manufacturing Challenges, Chicago, IL, October 16-18, 1989.

18. W.J. Parkinson, "PC-Based Expert Systems for Solving Some Engineering Problems at Los Alamos National Laboratory", Paper presented at the 6th DOE Workshop on Computer-Aided Engineering, Santa Fe, NM, October 23-25, 1989.

19. P.D. Shalek, W.J. Parkinson, S.R. Skaggs, D.J. Crill, J.E. Reynolds, and J.S. Parker, "Development of the Growth and Use of Long VLS-Derived Silicon Carbide Whiskers", Poster Session at the Fossil Energy Materials Program Conference, sponsored by the U.S. Dept. of Fossil Energy Materials Program Office, Oak Ridge, TN, August 8-10, 1989.

20. P.D. Shalek, and W.J. Parkinson, “Application of Artificial Intelligence Control to the Vapor-Liquid-Solid Silicon Carbide Whisker Process”, The Proceedings of the Materials Research Society 1989 Fall Meeting, Symposium L, “Chemical Vapor Deposition of Refractory Metals and Ceramics,” Boston MA, November 27-December 2, 1989.

21. W.J. Parkinson, P.D. Shalek, E.J. Peterson, and G.F. Luger, “Designing an Expert System for the Production of Silicon Carbide Whiskers,” Paper presented at the TMS Annual Meeting, Symposium-- Expert System Applications in Materials Processing & Manufacturing, Anaheim, California, February 19-22, 1990. Also in Expert System Applications in Materials Processing and Manufacturing, Ed. M.Y. Demeri, pp. 159-178, A Publication of TMS. Also in Department of Computer Science, College of Engineering, University of New Mexico Tech Report No. CS89-14.

22. W.J. Parkinson, G.F. Luger, and R.E. Bretz, “Three CLIPS-Based Expert Systems for Solving Engineering Problems”, Proceedings of The First CLIPS Conference, Houston, TX, Vol. 1, pp. 3-17, August 13-15, 1990.

23. W.J. Parkinson, G.F. Luger, R.E. Bretz, and J.J. Osowski, “An Expert System for Screening Enhanced Oil Recovery Methods”, Paper presented at The 1990 Summer National Meeting of the American Institute of Chemical Engineers, San Diego, CA, August 19-22, 1990.

24. W.J. Parkinson, K.H. Duerre, P.D. Shalek, E.J. Peterson, and G.F. Luger, “Expert Systems with Intelligent Process Control for Materials Production”, Paper presented at The Fifth Annual Meeting for AI in the DOE Complex, Idaho Falls, ID, October 9-11, 1990.

25. W.J. Parkinson, and K.H. Duerre, “Using the ASPEN Computer Code to Design and Evaluate Several Hazardous Waste Processes”, Paper presented at The 9th Biennial CUBE Symposium, Santa Fe, NM, November 27-30, 1990.

26. W.J. Parkinson, G.F. Luger, and R.E. Bretz, “An Expert System for Screening Enhanced Oil Recovery Methods”, Paper presented at The 9th Biennial CUBE Symposium, Santa Fe, NM, November 27-30, 1990.

27. W.J. Parkinson, and G.F. Luger, “An Expert Control System for the Production of Silicon Carbide Whiskers”, Paper presented at The 9th Biennial CUBE Symposium, Santa Fe, NM, November 27-30, 1990.

28. K.H. Duerre, W.J. Parkinson, and J.J. Osowski, “Enhanced Use of CLIPS at The Los Alamos National Laboratory”, Paper presented at The Second CLIPS Conference, Houston, TX, September 23-25, 1991.

29. M.W. Burkett, W.J. Parkinson, D.C. Nelson, and A.L. Bowman, “Rocky Flats Plant Incinerator Off-Gas Handling & Storage Concept Evaluation”, Los Alamos Technical Report, LA-UR-91-314 2, October 1, 1991.

30. W.J. Parkinson, and C.K. Rofer, ”Computer-Aided Plant Design Used to Evaluate Supercritical Water Oxidation Hazardous Waste Disposal Process Schemes”, Paper presented at The 7th DOE Workshop on CAE, Knoxville, TN, October 29-31, 1991.

31. W.J. Parkinson, K.H. Duerre, J.J. Osowski, G.F. Luger, and R.E. Bretz, “Screening Enhanced Oil Recovery Methods With Fuzzy Logic”, Paper presented at The Third International Reservoir Characterization Technical Conference, Tulsa, OK, November 3-5, 1991.

32. C.E. Polston, R.E. Bretz, R.E. Williams, and W.J. Parkinson, “Centrifuge Technology for Disposal Pit Closure”, Paper presented at The Fourth Annual Environmental, Safety, and Health Conference and Exhibition for the Oil, Gas, and Petrochemical Industries, Houston, TX, January 26-28, 1993.

33. W.J. Parkinson, P.D. Shalek, K.H. Duerre, G.F. Luger, and M. Jamshidi, “Two Intelligent Control Systems for Silicon Carbide Whisker Production”, Journal of Intelligent and Fuzzy Systems, Vol. 1, 199-214 (1993).

34. W.J. Parkinson, and C.K. Rofer, “Evaluation of Supercritical Water Oxidation Hazardous Waste Disposal Process Schemes Using the ASPEN Computer Code”, International Journal of Environmentally Conscious Design & Manufacturing”, Vol. 2, No. 1, 67-79 (1993).

35. W.J. Parkinson, R.E. Bretz, R.E. Williams, C.E. Polston, and Neal Miller, “Centrifuge Technology for Minimizing Petroleum Waste”, International Journal of Environmentally Conscious Design & Manufacturing”, Vol. 2, No. 1, 67-79 (1993).

36. W.J. Parkinson, and K.H. Duerre, “A Comparison of Crisp and Fuzzy Logic Methods for Screening Enhanced Oil Recovery Techniques”, Chapter 9 in Fuzzy Logic and Control, Software and Hardware Applications, Eds. M. Jamshidi, N. Vadiee, and T.J. Ross, pp. 181-216, Prentice Hall, (1993).

37. R. Steele, W.J. Parkinson, A. Graham, and N. Tetlow, “Oil Sludge Recovery Using a Continuous Three-Phase Centrifuge”, Paper presented at the Annual National Meeting of the American Institute of Chemical Engineers, St. Louis, MO, (November 1993).

38. W.J. Parkinson, G.F. Luger, R.E. Bretz, and J. Osowski, “Using an Expert System to Explore Enhanced Oil Recovery Methods”, Computers and Electrical Engineering, Vol. 20, No. 2, 181-197 (1994).

39. W.J. Parkinson, and K.H. Duerre, “Neural Nets for Distillation Column Control”, Los Alamos National Laboratory report LA-UR-94-902 (March 1994). Also in “Adaptive

Chemical Process Control: DuPont/Los Alamos Phase 1 Report", C.C. Baum, P.S. Bowling, S.K. Brown, K.L. Buescher, K.H. Duerre, V. Hanagandi, R.D. Jones, M.J. Messina, W.J. Parkinson, and M.J. Schmitt, Los Alamos National Laboratory report LA-UR-94-1040 (March 1994).

40. E.L. Joyce, W.J. Parkinson, N.S. Nogar, M. Trkula, S.M. Valone, B.R. Lally, and L.M. Matysiak, "Depleted Uranium Metal Preparation Using Hydrogen Plasma Technology", Paper presented at the 5th International Symposium on Robotics and Manufacturing, Wailea, Maui, HI, (August 1994).

41. C. Polston, R.E. Bretz, W.J. Parkinson, A.L. Graham, and R.D. Steele, "Three-Phase Centrifuge to Minimize Waste from Production Tank Bottoms and Sludges: An Economic Analysis", Paper presented at the Society of Petroleum Engineers SPE/EPA Environmental Conference '95, Houston, TX, (March 1995).

42. R.F. Hinde, W.J. Parkinson, R.D. Jones, S.K. Brown, C.C. Baum, P.S. Bowling, K.L. Buescher, and V.M. Hanagandi, "Adaptive Predictive Controller for Optimal Process Control", Paper presented at the ICALEPCS '95 Conference, Chicago, IL, (November 1995).

43. M.A. Meyer, T.R. Bement, M. Davidson, D.J. Hayden, R.A. Krajcik, F.N. Mortensen, W.J. Parkinson, and R.E. Smith, "Prototype Method for Quantifying Nuclear Package Reliability Using Expert Judgment (U)", (LA-CP-95-82), Defense Research Review, Vol. 7, No. 3, October 1996.

44. W.J. Parkinson, R.E. Smith, "An Intelligently Controlled 3-Phase Centrifuge for Waste Separation" (LA-CRADA-93C10072), Final Report, June 1997.

45. R.E. Smith, T.R. Bement, W.J. Parkinson, F.N. Mortensen, S.A. Becker, and M.A. Meyer, "The Use of Fuzzy Control System Techniques to Develop Uncertainty Distributions", Paper presented at the Joint Statistical Meetings (American Statistical Assoc., Institute of Math Stat, Biometrics Society, etc.), Anaheim, CA, August 10-14, 1997.

46. W.J. Parkinson, R.E. Smith, and N. Miller, "Control of a Three-Phase Oil Field Centrifuge, Using Fuzzy Logic", Paper presented at the Second Biennial Tri-Laboratory Engineering Conference on Modeling and Simulation, Santa Fe, NM, November 12-14, 1997.

47. W.J. Parkinson, R.R. Corle, and S.P. Abeln, "Beryllium Supply in the National Defense Stockpile", Los Alamos Technical Report, LA-13394-MS, October 31, 1997.

48. W.J. Parkinson, R.E. Smith, and N. Miller, "A Fuzzy Controlled Three-Phase Centrifuge for Waste Separation" Paper presented at the Bi-Annual Meeting of the World Automation Congress, Anchorage, AK, May 10-14, 1998.

49. W.J. Parkinson, R.E. Smith, P.J. Wantuck, and N. Miller, "A Fuzzy Control System for a Three-Phase Oil Field Centrifuge", Paper presented at the 2nd International Conference on Engineering Design and Automation, Maui, HI, August 9-12, 1998.

50. R.E. Smith, W.J. Parkinson, R.F. Hinde, P.J. Wantuck, and K.E. Newman, "Neural Network for Quality Control of Munitions Produced by Injection Molding", Paper presented at the 2nd International Conference on Engineering Design and Automation, Maui, HI, August 9-12, 1998.

51. C.E. Polston, W.J. Parkinson, S.P. Abeln, P.J. Wantuck, and R.R. Corle, "Simulating Beryllium Electrorefining with ASPEN Plus", Paper presented at the 2nd International Conference on Engineering Design and Automation, Maui, HI, August 9-12, 1998.

52. R.E. Smith, J.M. Booker, T.R. Bement, W.J. Parkinson, M.A. Meyer, and M. Jamshidi, "The Use of Fuzzy Control System Methods for Characterizing Expert Judgment Uncertainty Distributions", Proceedings of the 4th International Conference on Probabilistic Safety Assessment and Management, New York, NY, September 13-18, 1998.

53. R. Tolman, S. Xu, and W.J. Parkinson, "A New Gas Turbine Cogeneration System for Biomass", Paper presented at the ASME Conference on Renewable and Advanced Energy Systems for the 21st Century, Maui, HI, April 11-14, 1999.

54. M.A. Meyer, R.E. Smith, F.N. Mortensen, S. Becker, J. Morzinski, T.R. Bement, W.J. Parkinson, and M. Davidson, "Representing and Comparing Experts' Judgments on Nuclear Package Reliability (U)", (LA-CP-98-52), Defense Research Review, Vol. 8, No. 2, July 1999.

55. W.J. Parkinson, K.W. Hench, M.R. Miller, R.E. Smith, T.R. Bement, M.A. Meyer, J.M. Booker, and P.J. Wantuck, "The Use of Fuzzy Expertise to Develop Uncertainty Distributions for Machine Tool Wear", Paper presented at the 3rd International Conference on Engineering Design and Automation, Vancouver, BC, Canada, August 1-4, 1999

56. W.J. Parkinson, W.D. Birchler, L.F. Brown, and S.A. Schilling "Determining Bottlenecks in JTA Operations at LANL Using Extend Modeling", LA-UR-99-2449, Paper presented at the Tri-Lab Engineering Conference, Livermore, CA, November 3-5, 1999.

57. W.J. Parkinson, S.P. Abeln, K.L. Creek, P.J. Wantuck, T. Ross, and M. Jamshidi, "Application of Fuzzy Set Theory for Exposure Control in Beryllium Part Manufacturing", Paper presented at the World Automation Congress, Maui, HI, June 11-16, 2000.

58. R.E. Bretz, J.E. Marshall, and W.J. Parkinson, “Fuzzy Liquid Level Control of Surge Tanks in Series”, Paper presented at the World Automation Congress, Maui, HI, June 11-16, 2000.

59. W.J. Parkinson, P.J. Wantuck, M. Jamshidi, K.S. Patrick, and S.S. Jaffer, “Fuzzy Control of a Nonlinear Three-Tank System”, Paper presented at the World Automation Congress, Maui, HI, June 11-16, 2000.

60. K.W. Hench, W.J. Parkinson, and M.R. Miller, “Using Genetic Algorithms to Optimize a Fuzzy System for Predicting Tool Wear”, Paper presented at the World Automation Congress, Maui, HI, June 11-16, 2000.

61. W.J. Parkinson, R.E. Smith, and N. Miller, “Fuzzy Control System for an Oil Field Centrifuge”, (LA-UR-00-2603) Progress Report presented for the DOE Petroleum Technology Office Contractors Review Meeting, Denver, CO, June 26-29, 2000.

62. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, and K.S. Patrick, “Fuzzy Control for a Nonlinear-Mimo-Liquid Level Problem” (LA-UR-01-1081) Abstract, Paper presented at the 5th International Conference on Engineering Design and Automation, Las Vegas, NV, August 5-8, 2001.

63. W.J. Parkinson, K.W. Hench, S.P. Abeln, F.N. Mortensen, P.J. Wantuck, T. Ross, and M. Jamshidi, “Application of Fuzzy Set Theory to Attribute Data for Quality Control in Beryllium Part Manufacturing”, (LA-UR-01-1082) Paper presented at the 5th International Conference on Engineering Design and Automation, Las Vegas, NV, August 5-8, 2001.

64. Ross, Timothy J., Jane M. Booker, and W. Jerry Parkinson, eds., “Fuzzy Logic and Probability Applications: Bridging the Gap”, ASA-SIAM Series on Statistics and Applied Probability, SIAM, Philadelphia, ASA, Alexandria, VA, 2002 (also author or co-author of five chapters).

65. R.E. Smith, W.J. Parkinson, N. Miller, “Comparison of Soft Computing Techniques for a Three-Phase Oil Field Centrifuge” (LA-UR-01-6409, LA-UR-02-0356, LA-UR-02-3271) Paper presented at the World Automation Congress, Orlando, FL, June 2002.

66. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, T.J. Ross, N. Miller, “Fuzzy SPC Filter for a Feed-Forward Control System for a Three-Phase Oil Field Centrifuge”, (LA-UR-01-6410, LA-UR-02-0357, LA-UR-02-3410) Paper presented at the World Automation Congress, Orlando, FL, June 2002.

67. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, T.J. Ross, M. Jamshidi, N. Miller , “Fuzzy Feed-Forward/Feedback Control System for a Three-Phase Oil Field Centrifuge”, (LA-UR-02-1724, LA-UR-02-3225, LA-UR-02-4150), Sixth Annual Conference on Engineering Design & Automation, Maui, HI, August 2002.

68. W.J. Parkinson, R.E. Smith, T.J. Ross, N. Miller , “A Fuzzy Setup and Control System for a Three-Phase Oil Field Centrifuge” (LA-UR-02-0416, LA-UR-02-2499, LA-UR-02-6416), 52nd Canadian Chemical Engineering Conference, Vancouver, BC, Canada, October 2002.

69. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, T.J. Ross, N. Miller, “Fuzzy SPC Filter for a Feed-Forward Control System for a Three-Phase Oil Field Centrifuge”, Intelligent Automation & Soft Computing, Vol. 11, No. 1, pp 5-20, 2005

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Daniel Arima

Work experience

April 2004 - Present | Self-Employed; Co-owner Meldan Environmental Services | Riverton, Wyoming

Consultant

Provide services in obtaining permits from Wyoming Department of Environmental Quality, Bureau of Land Management, Wyoming Oil and Gas Commission and Bureau of Indian Affairs.

Monitor and maintain NPDES discharge water permits.

Coordinate reclamation of reserve pits, pads and pipelines.

Perform specialized sampling of water and soils associated with oil and gas industry.

Assist in developing closure plans for Petroleum Contaminated Soils (PCS).

Cooperate in study of bio-remediation of “sludges/waste byproducts” for water treatment and cleanup of PCS.

Manage recycling of oil from reserve pits, tank bottoms and other storage facilities.

1997 - 2004 | U.S. Energy Corp. | Riverton, Wyoming

Environmental Coordinator

Ensured all Federal, State and Local regulations and requirements were being fulfilled.

Established air and water monitoring program for field technicians.

Tracked all field air and water monitoring and sampling to ensure compliance with all permits and licenses.

Entered monitoring data into a working database for retrieval during reporting process.

Prepared and submitted applications for NPDES, Storm Water Discharge, Burn and Mining Permits.

Assisted in maintenance of two Nuclear Regulatory Commission licenses.

Land Manager - filed assessment fees for mining claims, familiar with BLM LR2000 database for claims and oil and gas leases.

Extensive searches in the County Courthouse for Leases, Right-of-ways and mineral lode claim filings.

1976 – 1997 | Umetco Minerals Corporation (Wholly owned subsidiary of Union Carbide)
Gas Hills, Wyoming

Project Engineer

Designed open pit mines and reclamation plans and costs estimates for working uranium mine and mill .

Assisted in the operation up until final reclamation of working uranium mine and mill.

Assisted in developing closure plan for an Uranium Mill Tailings Remedial Action Plant (UMTRAP) In Uravan, Colorado.

Aided in the design, management, and operations of the UMTRAP tailings relocation of the Susquehanna Mill tailings in Riverton, Wyoming to the Umteco’s Gas Hills facility.

Served as the Quality Control Officer inspecting numerous earthwork projects.

Responsible for furnishing and managing survey control using both conventional and Global Positioning Systems.

Prepared, managed and track costs forbid estimates and budgetary purposes.

Education

Graduated from Wind River High School in 1972

Attended the University of Wyoming for 2 years majoring in Geology

Community activities

Served on Church Parish Council as President

Served on Church’s Men’s Organization

Coached Youth Soccer, Football, Baseball and Basketball

References

References available upon request.

Taylor Environmental Consulting, LLC
Renee C. Taylor, Principle
P.O. Box 1743
Evansville, Wyoming 82636
(307) 236-2522
renee@taylor-environmental.com

STATEMENT OF QUALIFICATIONS

Renee Taylor has twenty nine years experience permitting oil and gas exploratory and development wells in Wyoming, Utah, Arizona, and Montana, as well as geothermal exploration wells in Hawaii. She has acted as project lead in obtaining permits for numerous federal and private lands exploratory drilling projects - some in extremely controversial and environmentally sensitive areas. These projects included a variety of complex NEPA issues and Endangered Species Act consultations. Obtaining these permits was often the result of long term negotiation and educational efforts that required considering the needs of the project proponent, the federal land manager, concerns raised by the public at large, other resource user groups, the conservation community and the environment.

Ms. Taylor has the experience and network available to provide full service production and operations environmental regulatory compliance permitting. She has experience with the full spectrum of BLM operating permits and plans of development including the various permits required by the BLM Operating Orders. She has worked closely with various State environmental agencies to obtain water, air and waste management permits required for drilling and production operations. Ms. Taylor has a good working knowledge of the pipeline and truck transportation industries and the Federal DOT regulations under which they operate, including emergency response planning. In addition, she has a good working knowledge of the federal OSHA regulations that affect these industries. She has written and implemented compliance plans for all these regulatory programs.

Renee Taylor understands and appreciates the point of view of the conservation community and the federal land management agencies. She has developed an ability to achieve consensus, or at least negotiated consensus, and team building. She is often asked to speak on issues of importance to the industries that are the backbone of the State of Wyoming. Ms. Taylor is also called upon as an information/education source for groups ranging from teachers to legislators.

SPECIFIC ENVIRONMENTAL REGULATORY COMPLIANCE EXPERIENCE

- Presented expert witness testimony regarding the adequacy of voluntary environmental mitigation efforts implemented by an oil and gas development company on private lands outside Glacier National Park.
- Advocated the introduction of thermal soil remediation in Wyoming for mitigating oil field contamination. Developed the permitting process and supervised the operations and compliance activities related to these projects.
- Presented expert witness testimony and field compliance relative to safety and environmental compliance for a geothermal development operation on the Big Island of Hawaii.
- Assisted the Bureau of Land Management (Wyoming State Office) in developing the hazardous materials disclosure process used in NEPA analysis and APD processing.
- Participated on the Wyoming Department of Environmental Quality Non-Point Source Task Force to approve projects and distribute funds for implementing projects to reduce sources of non-point source pollution.
- Represented the State of Wyoming on the Interstate Oil and Gas Compact Commission, Environmental and Safety Committee for almost 10 years, working with EPA and other participating states in developing the Environmental Compliance Audit program and other

environmental programs for consideration by the participating State agencies.

- Served as the project lead and company representative on the first EPA RCRA 7003 oil field waste clean–up project. Technologies used in this project included three stage centrifuge separation of waste streams, thermal remediation of contaminated soils, asphalt/road base reuse of centrifuge solids, and deep well non-hazardous waste injection of separated water.
- Prepared NEPA documents, permitting and guidance for an independent operating company working to re-develop existing oil fields using new, proprietary technology while mitigating existing surface disturbance and enhancing oil production.
- Conducted hundreds of Phase I and Phase II property assessments to inform potential buyers and lenders about the environmental condition of certain real properties and the challenges that may be associated with such transactions.

SPECIFIC WILDLIFE MANAGEMENT EXPERIENCE

- Worked on behalf of the oil and gas industry in conjunction with the Wyoming Game and Fish Department (WGFD) to address issues and needs raised in the conservation of sensitive species, specifically working on the Black Tailed Prairie Dog and Greater Sage-Grouse working groups.
- Crafted the draft Memorandum of Understanding (MOU) between the oil and gas industry and the U.S. Fish and Wildlife Service for the conservation of the Mountain Plover and represented a major land owner regarding protection of the Colorado Butterfly Plant.
- Represented industry in a process called the Cumulative Impacts Task Force, comprised of individuals from the Bureau of Land Management, conservation, the WGFD and the oil and gas industry.
- Conducted the field research that developed the information used by the FWS to define the range of the Preble's Meadow Jumping Mouse in Wyoming; participating on the FWS ESA Recovery Planning Team. Worked as consultant to private landowners and associations in developing their response to rulemakings as well as advising the staff of the Governor of the State of Wyoming regarding these issues.
- Completed research into the response of the Greater sage-grouse to oil and gas development in Wyoming (Greater Sage-grouse and Energy Development in Wyoming, 2007).

EMPLOYMENT

April 2005 -	Taylor Environmental Consulting LLC
1989 to 2005	Environmental Coordinator, True Oil LLC, Casper, Wyoming
1980-1989	Regulatory and Environmental Representative, Phillips Petroleum Company

EDUCATION

Since 1979	Ms Taylor has attended numerous environmental, health and safety courses including those required by various agency regulations. Special interest courses included the Rocky Mountain Mineral Law Foundation seminar on the Endangered Species Act, Ground Water Contamination and Mitigation, Hazardous Waste and CERCLA site remediation and mitigation, oil field waste management, air quality permitting for the oil and gas industry, drinking water system compliance and operating requirements, NEPA compliance, ESA conservation planning, Environmental Conflict Negotiations and numerous others.
1972-1978	BS in Agriculture, University of Arizona, major in Wildlife Ecology, minor in Range Science, with special emphasis on ecology and evolutionary biology.

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SUMMARY OF QUALIFICATIONS

- Over twenty-two (22) years experience Oil Analysis program management, implementation, and sustainment of materiel/equipment testing of major end items (aeronautical, combat, tactical, construction equipment)
- Proven ability in personnel supervision, program planning, funding, procurements, and logistics coordination
- Eleven (11) years experience as Contracting Officer Representative (COR); contract negotiations, developing statements of work, contractor surveillance, quality control, and quality assurance
- Skilled in oral and written communications; typing (40 wpm), briefings, reports, data collection, assessing policies and procedures, meetings, hosting conferences, training instructing, developing training curriculum for supported customers and workforce personnel; ISO 9000 certification, economic analyses, etc
- Experienced in generating and maintaining data bases that tracks equipment maintenance/repairs, abnormal findings, trends, purchases, inventories, and cost avoidance
- Experience in software applications i.e. Microsoft Office, Adobe Acrobat, etc.

Employment History

Oil Analysis Logistics Consultant — **Tech Research Corp, Ltd-Kuwait**
August 2003 – March 2004

Logistics Consultant — **ProReal GmbH-Germany/Romania**
June 2004 – Present
Cyrom Group, SRI, Romania
CCL Global Services, MI
Logistics Solutions, Europe

Deputy Director — **Mannheim Laboratory Center-Germany**
January 2001-July 2003

- Served as Deputy Program Manager of USAREUR Army Oil Analysis Program (AOAP) and Materiel Equipment Testing Laboratory. Provided oil analysis and materiel/equipment test support for all operating and maintenance activities within a widely dispersed geographical area (V Corp, AMC, Kuwait, Saudi Arabia, Qatar, Sinai, Italy, and the Balkans.
- Served as principal advisor for technical and administrative consulting services to command elements of USARUER and EUCOM. Planned, organized, and managed long-range annual and day-to-day work plans/schedules for three laboratory missions. Received, interpreted, and evaluated workload requests and requirements for in-service and contracted labs. Established objectives and standards for carrying out program requirements; assured implementation of all segments and functions of the USAREUR Oil Analysis and Materiel Testing Program.
- Managed laboratory expansion program of AOAP in Europe including planning, organizing, budgeting for establishing and maintaining additional laboratories. Reviewed and validated procurement packages, assuring proper completion of Purchase Requests and Commitment documents and performance work statements are accurate and clearly stated. Directed and organized teams in logistical disciplines of contract administration, contract management, contract quality assurance, and logistics procurement. Exercised detailed integral expertise and knowledge of concepts and application of quality assurance, logistical operations, and contract related issues for technical and complex commodities of aviation end items, combat and tactical equipment, logistics and supply. Responsible for investigating and inspecting contractor facilities/operations in USAREUR evaluating their ability to meet contract requirements. Issued approvals with implementing instructions providing continual monitoring and surveillance of approved facilities, analysing discrepancies and effecting corrective action.

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- Served as Contracting Officer's Representative (COR) conducting pre-award and post-award functions that included funding requirements/accountability, developing statements of work, review of solicitation proposals, contract negotiations, source vendor coordination, contract modifications, developing performance standards, monitoring contractor's performance/contract surveillance, review of settlement proposals, expediting invoice payments, conducting inspections of contractor facilities. Served as principal advisor to Contracting Officer on statement of works, technical exhibits, and manpower requirements. Served as principal rater of Contractor during the performance period.

- Conducted studies, prepared project papers, and staff reports, covering areas such as mission impact, customer compliance, cost effectiveness, and cost avoidance (designed, implemented agency and program procedures which lead to Army-wide software application upgrades in tracking equipment maintenance, equipment densities, program compliance, and cost avoidance. Average cost of program implementation for USAREUR theatre $1.2M per fiscal year; average cost savings per fiscal $7M). Developed and delivered formal and informal briefings MACOM representatives, commanders, maintenance managers, and foreign governments; represented USAREUR theatre at meetings and conferences; received/assessed information on test procedures from manufacturers, technical, scientific and managerial personnel concerning program applicability. Attended meetings on standards, methods, guidelines for various laboratory disciplines, providing advice and guidance on interpretation of U.S. standards. Provided oversight of theatre wide customer training education program to enhance effectiveness of AOAP and preventive maintenance. Conducted recurring on-location orientation and training of field units to ensure success of current and newly instituted programs. Maintain continual contact with representatives of commands concerning abnormalities, improvements, or field problems.
- Directly and through subordinate supervisors planned, distributed, and prioritized the work of 27 professional, technical, and administrative employees. Set and approved performance standards for all employees; evaluated performance of subordinate supervisors and approved all other appraisals; initiated and approved formal documents associated with recruitment, position classification, awards, training, performance, etc. Resolved complaints, grievances; initiated and effected disciplinary actions with the assistance of personnel specialists. Performed interviews, selected and/or approved selection of candidates.

Oil Analysis Management Specialist / Chief of Administration
USAREUR Materiel Equipment and Oil Analysis Laboratories
November 1992-2001

- Provided management guidance, staff and technical assistance to major commands/subordinate elements (HQ USAREUR, V Corps, AMC) and other activities/agencies within a widely dispersed geographical area (European theater, Kuwait, Saudi Arabia, Qatar, Sinai, and the Balkans [I-FOR/S-FOR/K-FOR]) relating to the utilization, support, and application of the Army Oil Analysis Program.
- Developed and monitored broad plans providing recommendations, presentation materials, and other written correspondence to major commands and sub-elements pertaining to implementation of new/revised policies/ procedures, methodology, user participation, support operations, budget projections, and mission requirements. Initiates and coordinates resolutions to problems pertaining to contingency operations, logistics assistance, readiness reporting, and operations planning of the Army Oil Analysis Program.
- Performed surveillance of program objectives/directives, trends, program participation, cost analyses and cost avoidance. Served as the authority for capturing, tracking, maintaining, and reporting all statistical data relevant to program compliance. Responsible for developing/designing/modifying, automated programs that simplify tracking, reporting, and output processes of data collection (designed output software format) (OPA) for tracking statistics of the USAREUR Oil Analysis Program. Evaluated laboratory mission effectiveness, timeliness of work accomplishment, quality of work, and adequacy of procedures and controls. Evaluated existing regulations and propose recommended changes as needed.

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- Researched and conducted studies for cost comparisons; analyzes & documents findings of economical reviews; develops monthly & fiscal reports for review/analysis to higher headquarters, MACOM levels, and other commands relevant to mission requirements, policy, and program management. Conducted on-site visits at organizational, direct support, and general support maintenance facilities to ensure compliance with established regulatory requirements.

- Action officer for procurements [i.e. laboratory analytical equipment, supplies, materials, and chemicals; ADP equipment; service/support contracts. Served as action officer for special projects [i.e. transfer of mission functions, foreign military sales (FMS) cases], advisor/liaison at meetings, conferences, and special military to military programs. Action officer for ISO 9000 certification and
- Primary Coordinator and chief instructor of the US Army Europe AOAP Training/certification program which consisted of 25 formal classes/over 400 participants per fiscal to approximately 500 military units throughout USAREUR . Provided on-site training to various commands and agencies. Coordinated and developed materials for training aids, SOP manuals, policies & directives; researches, analyzes, and develops scope of content in accordance with mission requirements, customer needs, and regulatory policy.
- Served as project officer for personnel deployments, transport of supplies, and logistics coordination in support of contingency operations to include pre-deployment training, transportation orders, security, equipment issue (clothing/gear), and movement control. Provided management execution for 3 oil analysis laboratory sites. Provided assessments on determining site locations for new laboratories; developed facility blueprints/designs and configurations.
- Served as Contracting Officer's Representative (COR) conducting pre-award and post-award functions that included funding requirements/accountability, developing statements of work, review of solicitation proposals, contract negotiations, source vendor coordination, contract modifications, developing performance standards, monitoring contractor's performance/contract surveillance, review of settlement proposals, expediting invoice payments, conducting inspections of contractor facilities. Served as principal advisor to Contracting Officer on statement of works, technical exhibits, and manpower requirements. Served as principal rater of Contractor during the performance period.
- Supervised personnel management functions and office administration under MARKS filing system to include development of performance standards, preparation of performance appraisals, time and attendance, leave approval, payroll, and initiating personnel actions. Advised staff personnel on career, educational and developmental needs/opportunities; developed work schedules, developing/implementing internal controls ensuring facility security, scheduling/coordination of functions/events, maintaining office equipment and office supplies; Supervised all administrative functions relevant to personnel, workforce training requirements, specialized training from outside agencies, individual developmental programs, and information management.

EDUCATION
High School Cape Fear High, Vander N.C.
TRAINING
Business Management Training/BMT 1-4 Manager's Course, 08/21/1992-09/09/1992
Nuclear, Biological & Chemical Training, 03/1991
Deployment/Individual Readiness Course, 06/22/1996-06/26/1996
Motor Vehicle Defensive Driver Course, 09/1989
Force Protection Level 1/Category II Training, 10/1997
Individual Readiness Training, 06/1996
Contracting Officer Representative Course,(Service/Construction Contracts) 10/1993, 10/1996, 08/1999
Army Management Staff College Workshop, 08/08/99-08/20/99
Training/Instruction In Prevention of Sexual Harassment, 12/2000

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WILLIAM STEWART GODWIN

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SUMMARY OF QUALIFICATIONS

I am a highly skilled and proven leader able to make difficult decisions while managing multiple, high-visibility programs. I have personally directed profit centers worth over $250 Million USD per year, lead organizations of several thousand people, and managed my own successful business. I hold several professional certifications including Certified Management Consultant, Practitioner Fellow of the Association of Proposal Management Professionals, Project Management Professional (through the Project Management Institute), Six Sigma Master Black Belt and Lean Manufacturing certifications. I have also had extensive experience in the following broad-based competencies:

Continual Process Improvement	**Demand Forecasting**	**Customer Relationship Management**
Project/Program Management	**Strategic Planning**	**Lean Manufacturing Principles**
Earned Value Management	**Risk Management**	**New Business Development**

PROFESSIONAL WORK HISTORY

10/05 – PRESENT GENERAL MANAGER, DIGNOW MANAGEMENT CONSULTING, SHARQ, KUWAIT

DMC provides innovative business solutions to a variety of clients across multiple industries. Based in the Middle East and focused on Kuwait specifically DMC also has a global reach supporting organizations in China, Europe, and the United States. I personally created and lead the DMC team from the ground up establishing our team as a premier organization in Kuwait. Drawing upon my extensive senior management experience, thorough knowledge of the local market, and customer focus I was able to triple the organizations client base within our first thirty days in the Middle East. DMC is routinely sought after to provide consulting management services, risk survey and mitigation reporting, and general strategic planning services.

- Provided the technical expertise needed to develop the Health, Safety, and Environmental Management System and Physical Security Systems in place at a 2.25 million square foot logistics facility in Kuwait utilized by commercial and government clients.
- Built an in house business development department and US Government contracting department for a dominant general contracting firm in the Gulf region. The team DMC created has already won a $350 Million USD construction contract spanning 3 years and four countries.
- Provided knowledge management services to a Kuwait logistics company which allowed them to win over $1.6 Million USD with US government contractors in less then 150 days.
- Personally developed and lead the proposal team which successfully bid on over $3.4Billion USD worth on contracts since December 2006. The contracts range from transportation and logistics services to dining facility operations, to bottled water and ice deliveries throughout the GCC region, to real estate developments throughout the Asia Pacific region.

10/04 – 10/05 DIRECTOR: STRATEGIC PLANNING, AGILITY, SULABIYA, KUWAIT

Built and lead a cross-functional, matrixed organization to provide strategic direction to PWC's corporate policies and decisions. The Strategic Planning Group (SPG) was instrumental in developing corporate policies based on industry best practices, standardization, and personal accountability throughout the corporate infrastructure. The SPG also provided solid long term intelligence to aid top leadership in planning the overall corporate direction of PWC.

- Personally lead the proposal team that successfully won the five year follow on contract to provide and operate the US Defense Distribution Depot in Kuwait (DDKS). This was a $178 Million program encompassing 1 million square feet of climate controlled warehouse space and 1 million square feet of outside storage area as well as all staff and material to run the facility for the US government. All aspects of engineering and design were handled internally by my team.
- Developed the operational plan submitted in the successful proposal to provide the US Army with heavy lift transportation assets. The plan encompassed daily missions throughout Iraq and Kuwait, fleet maintenance for over 2500 vehicles, HR management for the staff of over 3000, and all reporting, communications, safety, security, and tracking services to be provided to the US Army. The total contract value was over $2.1 Billion during the five year period.
- Planned the construction of a 2,000,000 square meter facility consolidating all US Military logistical activity in Kuwait into a single secured state-of-the-art facility. Annual revenue is expected to exceed $750,000,000 a year with a multi-decade lease agreement.

03/04 – 10/04 PROJECT DIRECTOR, AGILITY, SULABIYA, KUWAIT

Lead a four county multi-national team to assist the Defense Energy Support Center (DESC) in delivering Humanitarian Fuel to Iraq. Over 5,000,000 gallons of fuel were imported *daily* in support of Iraq's reconstruction efforts over the course of this $170 Million program. A team of over 400 personnel located in Iraq, Jordan, Turkey, and Kuwait were required to maintain proper management and oversight of the fuel operations. In less than 30 days three separate country offices were set up, staffed, and operationally managing the operation for DESC.

- Metrics were developed from scratch to monitor the loading of fuel outside of Iraq, the movement of the fuel through the satellite countries, across the Iraqi border, and to more than 17 depot stations and thousands of retail outlets within Iraq.
- Coordinated supply, shipping and security in a challenging logistical situation which involved coordinated insurgent attacks, riots, interdicted supply routes and blown pipelines. Personally developed and implemented our product loss prevention program.
- Managed relations with the Coalition Provisional Authority, the US military and the Iraqi government. Routinely briefed the highest echelons of DESC staff including US Military Leadership to the Lieutenant General (three star) level.

For more detailed information on the portfolio of projects I have been directly involved in please visit me on the web at
www.stewartgodwin.com

04/02 – 03/04 **SR. PROGRAM MANAGER, INTEGRATED DEFENSE TECHNOLOGIES, FT. WALTON BEACH, FL**

Responsible for three major programs worth more than $110 million over three fiscal years. I was the lead PM on the Service Technical Support (STS) and Joint Strategic Lightweight Nuclear Biological Chemical Reconnaissance System (JSLNBCRS). I was also the PM responsible for the manufacturing integrated product team (IPT) on the Light Armored Vehicle Service Life Extension Program (LAV SLEP). Responsible for all profit and loss and earned value reporting. Interact daily with design and manufacturing engineers as well as all ranks of military personnel. Provided daily supervision to multiple IPT's encompassing 32 supervisor level personnel spanning seven cross functional business areas.

- Less than sixty days after stepping into the lead PM role on the STS program I was able to move six of the nine behind schedule work directives back on track and the remaining three ahead of schedule. Also successfully renegotiated the scope of the program bringing in an additional $3.5 million.
- Developed the program schedule and lead the IPT that successfully completed IDT's launch of a $4 million Oracle ERP system.
- After attending Lockheed-Martin's Lean Manufacturing course I redesigned three company processes (one in programs & marketing, one in engineering, and one in manufacturing) that have eliminated more than $2 million in hard costs in less than six months.

10/99 – 04/01 **DIRECTOR OF PLANT OPERATIONS, MIRRO COMPANY, MANITOWOC, WI**

Responsible for the daily production of Mirro's polished cookware line. Daily quotas exceeded 34,000 items. Managed all aspects of my line's supply chain management, customer service management, personnel recruitment, manufacturing process improvements, material control, the line's spatial deployment, and finally delivery to customer locations. Had P&L responsibility for the line so I identified and implemented cost savings programs to eliminate waste from a $3.7 million annual budget. Directly supervised the daily activities of up to six managers and 82 line employees.

- Developed and instituted a data-base driven personnel safety program which reduced OSHA recordable accidents by 40% in less than six months.
- Designed and then managed a project which installed a $250,000 equipment upgrade while still reducing scrap and downtime by 3%.

07/98 - 10/99 **CANDIDATE RECRUITER, BRADLEY-MORRIS, INC., ATLANTA, GA**

Developed marketing materials, training programs, and interpersonal relationships aimed at preparing qualified military candidates for the civilian job market. Identified and isolated markets for specific program recruitment. Presented the Bradley-Morris marketing plan to targeted groups. Worked with qualified candidates on a one-on-one basis to improve their written resumes, interviewing skills, and total marketability. Developed a database program to manage candidate and client information.

- Handpicked to launch the Bradley-Morris Medical Division, unique to the entire military recruiting industry. Designed the company's website.
- Created multiple marketing tools used to attract and then screen candidates for our placement program.

07/96 - 11/98 **LOGISTICS OFFICER, US AIR FORCE, MOODY AIR FORCE BASE, GA**

Over the course of my military career I supervised 55 mid-level managers and 215 personnel assigned to three major flights. I directed up to three real world combat deployments at any given time and was accountable for 11,287 precision tuned mobility bags, 2,805 weapons, over 300,000 square feet of storage space, over 100,000 line items of stock, and seven different facilities valued at over $500 million.

- Personally directed the construction of a new $278 million centralized 90-day hazardous material accumulation area. Coordinated everything from design and construction to appropriation of funds including daily interaction with contractors.
- Limited aircraft grounded due to supply problems to at least 3% under Air Combat Command's (ACC) standard. Led ACC in repair cycle turn around time ensuring more missions were flown.
- Responsible for the on-line Supply indoctrination program for new airmen, ensuring that the speed and accuracy of their training was 12% better than the ACC standard.
- Hand picked to lead the cross-organizational team in charge of successfully testing and integrating the new logistics/maintenance software GOLD.
- Personally developed manual procedures for the operation of all Supply functions during critical times of power outage and loss of computer operation.

EDUCATION & PROFESSIONAL DEVELOPMENT

Professional Development & Certifications

- **Association of Proposal Management Professionals – Practitioner Fellow Certification** **2007**
- **Professional Management Consultant Certification** **2006**
- **Master Black Belt Certification** **2005**
- **Six Sigma Black Belt Certification** **2003**
- **Six Sigma Green Belt Certification** **2003**
- **Project Management Professional Certification** **2003**
- **Critical Tools WBS/PERT Software Training** **2002**
- **Lean Leadership Training Course (LM21)** **2002**
- **Defense Acquisition University Level II Certification** **2000**

US AIR FORCE ACADEMY	***Bachelors of Science in Civil Engineering***	**1996**
DUKE UNIVERSITY	***Global Executive MBA***	**2002**

For more detailed information on the portfolio of projects I have been directly involved in please visit me on the web at www.stewartgodwin.com

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Date of Birth: 06/02/1982

Hesham Talaat Attia

Objective

My objective is to receive a position where I can gain work experience and expand on what I have studied in my undergraduate and post graduate programs.

Academic Qualifications

1992 - 1998 New English School Jabriyah

IGCSE Certificate

- Passed 9 IGCSE's, with a grade of B or better.
- Passed A/S Math, with a B grade.

1998 - 2003 Kuwait University Khaldiya

Undergraduate Studies

- Graduated with a Bachelor of Science (B.Sc.) in Electrical Engineering, with a 3.21/4.00 GPA.

2003 - 2007 Kuwait University Khaldiya

Post Graduate Studies

- Master of Science (M.Sc.) in Electrical Engineering, with a 3.48/4.00 GPA.
- Successfully completed the defense of my master's thesis, entitled "Optimization of Constrained Nonlinear Dynamical Systems".

Publications

- Presentation of a paper entitled "A Multilevel Algorithm for the Solution of Constrained Nonlinear Optimization Problems", at the Conference on Systems and Control (CSC'2007), Marrakech Morocco, May 16-18, 2007.
- Received acceptance for the publication of a paper entitled "Stream Quality Control via a Constrained Nonlinear Model" in the *Journal of Mathematical Control Science and Applications*.
- Pending acceptance of a paper entitled "A Coordinating Approach for Solving Constrained Nonlinear Optimization Problems" in the *Journal of Optimization Theory and Applications*.
- Pending acceptance of a paper entitled "A Distributed Controller for Constrained Interconnected Systems with Time Delays" in the *International Journal on Modeling Identification and Control*.

Experience	▪ 2005 – 2007 Worked as a T.A. at Kuwait University for 4 semesters Subjects taught: ▪ Probability and Statistics for Engineers ▪ Fundamentals of Electrical Circuits ▪ 2007 - Present The Amercain Bilingual School Khaitan Secondary Mathematics Teacher ▪ Teaching Mathematics to grades 6, 8 and 11. ▪ Teaching an SAT prep course for graduating high-school students.
Languages	Fluent in English and Arabic, conversational and written.
Computer Skills	Fortran, Matlab and Microsoft Office.
Interests and activities	I.T., Music, Reading and Sports.
Awards received	Received five awards for being an outstanding student at Kuwait University.
References	Prof. Mohamed Fahim Hassan Tel: (+965)4987634 Email: mfahim@eng.kuniv.edu.kw Mr. Omar Zaghloul Tel: (+965)6951360 Email: zaghloul@yahoo.com

Ronald E. Smith

PO Box 1663, MS C914
Los Alamos National Laboratory
Los Alamos, NM 87545

Education

Ph.D. Chemical Engineering, University of Wisconsin-Madison, Madison, WI, May 1994. Thesis: Automated Computer-Aided Design of Control Systems Through Artificial Intelligence

B.S. Chemical Engineering, Lehigh University, Bethlehem, PA, June 1986.

Professional Experience

5/94-present: **Technical Staff Member**, Los Alamos National Laboratory
Major projects:

- Design and implementation of fuzzy logic control system and expert advisor for a three-phase centrifuge for remediation of oil field wastes (with Centech Inc., Casper, WY, 1994-1996, 1999-2005). Patent: "System and Process for Separating Multi Phase Mixtures using Three Phase Centrifuge and Fuzzy Logic", Neal J. Miller, William Jerry Parkinson, Ronald E. Smith, U.S. Patent No. 6,860,845, issued March 1, 2005.
- PREDICT methodology – Methodology for predicting reliability of complex systems (1996-2007) – co-developer on 1999 R&D 100 award
- Non-destructive testing and evaluation (2006-present).

Expertise & Interests

Intelligent and adaptive process control - fuzzy logic, neural networks, model predictive control. Control system design and evaluation. Expert system development. Reliability estimation. Non-destructive testing and evaluation.

Publications

See attached list.

Professional Affiliations

American Institute of Chemical Engineers (AIChE, since 1986)

Ronald E. Smith

Publication List

1. R.E. Smith and W.H. Ray, "Automated Computer-Aided Design of Control Systems Through Artificial Intelligence", Paper presented at AIChE Annual Meeting, San Francisco, CA, November 1994.

2. M.A. Meyer, T.R. Bement, M. Davidson, D.J. Hayden, R.A. Krajcik, F.N. Mortensen, W.J. Parkinson, and R.E. Smith, "Prototype Method for Quantifying Nuclear Package Reliability Using Expert Judgment (U)", (LA-CP-95-82), Defense Research Review, Vol. 7, No. 3, October 1996.

3. W.J. Parkinson, R.E. Smith, "An Intelligently Controlled 3-Phase Centrifuge for Waste Separation" (LA-CRADA-93C10072), Final Report, June 1997.

4. S.A. Becker, T.R. Bement, M.A. Meyer, F.N. Mortensen, W.J. Parkinson, R.E. Smith, "Rule-Based Performance Prediction and Reliability Forecasting Methodology", (LA-CP-97-0143, LA-CP-97-0182, LA-UR-97-3218), 21st Aging Compatibility & Stockpile Stewardship Conference, Albuquerque, NM, October 1997.

5. R.E. Smith, T.R. Bement, W.J. Parkinson, F.N. Mortensen, S.A. Becker, and M.A. Meyer, "The Use of Fuzzy Control System Techniques to Develop Uncertainty Distributions", Paper presented at the Joint Statistical Meetings (American Statistical Assoc., Institute of Math Stat, Biometrics Society, etc.), Anaheim, CA, August 10-14, 1997.

6. W.J. Parkinson, R.E. Smith, and N. Miller, "Control of a Three-Phase Oil Field Centrifuge, Using Fuzzy Logic", Paper presented at the Second Biennial Tri-Laboratory Engineering Conference on Modeling and Simulation, Santa Fe, NM, November 12-14, 1997.

7. W.J. Parkinson, R.E. Smith, and N. Miller, "A Fuzzy Controlled Three-Phase Centrifuge for Waste Separation" Paper presented at the World Automation Congress (WAC 1998), Anchorage, AK, May 10-14, 1998.

8. W.J. Parkinson, R.E. Smith, P.J. Wantuck, and N. Miller, "A Fuzzy Control System for a Three-Phase Oil Field Centrifuge", Paper presented at the 2nd International Conference on Engineering Design and Automation, Maui, HI, August 9-12, 1998.

9. R.E. Smith, W.J. Parkinson, R.F. Hinde, P.J. Wantuck, and K.E. Newman, "Neural Network for Quality Control of Munitions Produced by Injection Molding", Paper presented at the 2nd International Conference on Engineering Design and Automation, Maui, HI, August 9-12, 1998.

10. R.E. Smith, J.M. Booker, T.R. Bement, W.J. Parkinson, M.A. Meyer, and M. Jamshidi, "The Use of Fuzzy Control System Methods for Characterizing Expert Judgment Uncertainty Distributions", Proceedings of the 4th International Conference on Probabilistic Safety Assessment and Management, New York, NY, September 13-18, 1998.

11. J.M. Booker, R.E. Smith, T.R. Bement, M.A. Meyer, W.J. Parkinson, "Example of Using Fuzzy Control System Methods in Statistics", (LA-UR-99-1712), Spring 1999 SPES Newsletter, Section on Physical and Engineering Sciences of ASA.

12. M.A. Meyer, R.E. Smith, F.N. Mortensen, S. Becker, J. Morzinski, T.R. Bement, W.J. Parkinson, and M. Davidson, "Representing and Comparing Experts' Judgments on Nuclear Package Reliability (U)", (LA-CP-98-52), Defense Research Review, Vol. 8, No. 2, July 1999.

13. W.J. Parkinson, K.W. Hench, M.R. Miller, R.E. Smith, T.R. Bement, M.A. Meyer, J.M. Booker, and P.J. Wantuck, "The Use of Fuzzy Expertise to Develop Uncertainty Distributions for Machine Tool Wear", Paper presented at the 3rd International Conference on Engineering Design and Automation, Vancouver, BC, Canada, August 1-4, 1999

14. J.M. Booker, R.E. Smith, T.R. Bement, S.M. Parker, "Statistical Approach to Fuzzy Control System Methods for Uncertainty Distributions" (LA-UR-99-2112, LA-UR-99-6492) Paper presented at World Automation Congress (WAC 2000), Maui, HI, June 11-16, 2000.

15. M.A. Meyer, J.M. Booker, R.E. Smith, K.B. Butterfield, W.S. Murray, "Eliciting Expert Judgment for Fuzzy or Probabilistic Applications" (LA-UR-99-2983, LA-UR-99-6481) Paper presented at World Automation Congress (WAC 2000), Maui, HI, June 11-16, 2000.

16. W.J. Parkinson, R.E. Smith, and N. Miller, "Fuzzy Control System for an Oil Field Centrifuge", (LA-UR-00-2603) Progress Report presented for the DOE Petroleum Technology Office Contractors Review Meeting, Denver, CO, June 26-29, 2000.

17. S.W. Eisenhawer, T.F. Bott, R.E. Smith, "An Approximate Reasoning-Based Method for Screening High-Level-Waste Tanks for Flammable Gas", Nuclear Technology, Vol. 130, No. 3, June 2000.

18. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, and K.S. Patrick, "Fuzzy Control for a Nonlinear-MIMO-Liquid Level Problem" (LA-UR-01-1081) Paper presented at the 5th International Conference on Engineering Design and Automation, Las Vegas, Nevada, August 5-8, 2001.

19. Timothy J. Ross, Jane M. Booker, and W. Jerry Parkinson, eds., “Fuzzy Logic and Probability Applications: Bridging the Gap”, ASA-SIAM Series on Statistics and Applied Probability, SIAM, Philadelphia, ASA, Alexandria, VA, 2002 (co-author of three chapters).

20. J.M. Booker, W.J. Kerscher, R.E. Smith, “Assessing Processes in Uncertain, Complex Physical Phenomena and Manufacturing”, (LA-UR-01-3923, LA-UR-02-0519, LA-UR-02-3537), Proceedings of the 6th International Conference on Probabilistic Safety Assessment and Management, San Juan, PR, June 2002.

21. R.E. Smith, W.J. Parkinson, N. Miller, “Comparison of Soft Computing Techniques for a Three-Phase Oil Field Centrifuge” (LA-UR-01-6409, LA-UR-02-0356, LA-UR-02-3271) Paper presented at the World Automation Congress (WAC 2002), Orlando, FL, June 2002.

22. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, T.J. Ross, N. Miller, “Fuzzy SPC Filter for a Feed-Forward Control System for a Three-Phase Oil Field Centrifuge”, (LA-UR-01-6410, LA-UR-02-0357, LA-UR-02-3410) Paper presented at the World Automation Congress (WAC 2002), Orlando, FL, June 2002.

23. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, T.J. Ross, M. Jamshidi, N. Miller , “Fuzzy Feed-Forward/Feedback Control System for a Three-Phase Oil Field Centrifuge”, (LA-UR-02-1724, LA-UR-02-3225, LA-UR-02-4150), Sixth Annual Conference on Engineering Design & Automation, Maui, HI, August 2002.

24. W.J. Parkinson, R.E. Smith, T.J. Ross, N. Miller , “A Fuzzy Setup and Control System for a Three-Phase Oil Field Centrifuge” (LA-UR-02-0416, LA-UR-02-2499, LA-UR-02-6416), 52nd Canadian Chemical Engineering Conference, Vancouver, BC, Canada, October 2002.

25. W.J. Kerscher, J.M. Booker, M.A. Meyer, R.E. Smith , “PREDICT: A Case Study Using Fuzzy Logic”, (LA-UR-02-0732), Paper presented at International Symposium on Product Quality & Integrity, Tampa, FL, January 2003.

26. W.J. Parkinson, R.E. Smith, F.N. Mortensen, P.J. Wantuck, M. Jamshidi, T.J. Ross, N. Miller, “Fuzzy SPC Filter for a Feed-Forward Control System for a Three-Phase Oil Field Centrifuge”, Intelligent Automation & Soft Computing, Vol. 11, No. 1, pp 5-20, 2005

27. G. Park, M.T. Bement, D.A. Hartman, R.E. Smith, C.R. Farrar, “The Use of Active Materials for Machining Processes: A Brief Review”, International Journal of Machine Tools and Manufacture, Vol. 47, Issue 15, pp. 2189-2206, December 2007.

CURRICULUM VITAE
LAURO M. MALONZO

Block 7 – Lot 14B, Don Juan Bayview Subd.,
Sucat, Muntinlupa City
Cell Phone No. 0063 9202580002 (Philippines)
Cell Phone No. 00965 6913385 (Kuwait)
Email: malonzolarry2000@yahoo.com

PROFESSIONAL QUALIFICATION:

GRADUATE	:	Computer Technology, 1990 Polytechnic University of the Philippines
	:	Bachelor in Civil Engineering, 1986 Polytechnic University of the Philippines

WORK EXPERIENCE:

Oct. 21, 2006 – Present	Quantity Surveyor (Main Office, Tendering Department) Combined Group Contracting Co. Safat, Kuwait
April 2005 – July 24, 2006	Quantity Surveyor (Road Construction Co.) Al Mehthel Trading & Contracting Est. Najran, Saudi Arabia
Nov. 2002 – Nov. 2004	:Quantity Surveyor / Design Engineer (Road Const. Co.) Al Ayuni Trading & Contracting Co. Riyadh, Saudi Arabia
Dec. 1998 – Dec. 2000	:Civil Engineer (Precast & Building Construction Co.) Rabiah & Nassar Co. Riyadh, Saudi Arabia
Sept. 1992 – Dec. 1998	:Civil Engineer / Computer Programmer (Road Const. Co.) Saleh & Abdulaziz ABAHSAIN Co., Ltd. Riyadh, Saudi Arabia
June 1991 – June 1992	:Civil Engineer / Computer Engineer (Residential Projects) Abdulla B. Al-Khalifa & Sons Co. Al-Khobar, Saudi Arabia
July 1986 – May 1991	:Project Evaluator (Irrigation Project) National Irrigation Administration Quezon City, Philippines

EMPLOYMENT HIGHLIGHTS:

October 21, 2006 – Present

Firm : Combined Group Contracting Co.
Safat, Kuwait

Position : Quantity Surveyor

Duties and Responsibilities:

- Make quantity take-off for the assign project for tendering purposes for infrastructure project such as Sanitary pipeline, Storm drainage line, Manhole, Culverts and all other items showing in the design drawings.
- Calculate quantity take-off for the roads such as volume of Cut and Fill, Sub-grade, Asphalt, Curbstone and other item involve in the construction of the roads including site clearing.
- Review specification and proposals prepared by consultants on behalf of the Owner or the Ministry (Government Project).
- Submit quotation to the sub-contractor for pricing, follow-up quotation , evaluation of price quotations and prepare comparative statements and rate analysis.
- Carried out various activities pertaining to tender department and familiarize with pre-tender and post tender activities

April 2005 – July 24, 2006

Firm : Al Mehthel Trading & Contracting Est.
Najran, Saudi Arabia

Position : Quantity Surveyor

Duties and Responsibilities:

- Prepare Quantities of all structures such as Irish Crossing, Concrete Slope Protection, Reinforce Concrete Box Culvert (RCBC) and all other concrete works based on approved shop drawing.
- Collect and input data's such as Natural Ground Level and Profile Grade to prepare Cut & Fill Quantity.
- Monitor all the on-going projects in the assign area in order to calculate the quantity accomplished such as volume of quantity (Cut & Fill), Bituminous Wearing Course, Bituminous Base Course, Bituminous Prime Coat, Sub-grade, and all structures completed for our Monthly Payment Certificate (Monthly Billing).
- Preparing design elevation for Irish Crossing. Concrete Slope Protection, Reinforce Concrete Box Culvert (RCBC) and Reinforce Concrete Pipe Culvert (RCPC) as per approved design manuals of Ministry of Transport.
- Provide Site Engineer/Surveyor final elevation such as Top of Embankment, Top of Sub-grade and Top of Asphalt.
- Prepare shop drawing for all structures using AutoCAD software based on the specification provided by the consultant and approved by the Ministry of Transport.
- Prepare Horizontal Curve Report data for the calculation of Super Elevation data.
- Review with project consultants all design details and submittal, ensuring compliance to regulations, value engineering and most economical solutions have been adopted.

- Serve as the Department's Quantity Surveyor representative with external Consultants and Contractors.
- Works closely with other project management team members to ensure smooth coordination and achievements of excellence in all aspects of the project.
- Handle other essential tasks as assigned.

November 2002 – November 2004

Firm : Al Ayuni Trading & Contracting Co.
Riyadh, Saudi Arabia

Position : Quantity Surveyor and Design Engineer

Duties and Responsibilities:
- Preparing design elevation for Irish Crossing. Concrete Slope Protection, Reinforce Concrete Box Culvert (RCBC) and Reinforce Concrete Pipe Culvert (RCPC) as per approved design manuals of Ministry of Transport.
- Prepare shop drawing for all structures using AutoCAD software based on the specification provided by the consultant and approved by the Ministry of Transport.
- Prepare Quantities of all structures such as Irish Crossing, Concrete Slope Protection, Reinforce Concrete Box Culvert (RCBC) and all other concrete works based on approved shop drawing.
- Prepare Horizontal and Vertical Alignment using Softdesk Program.
- Monitor all the on-going projects in the assign area in order to calculate the quantity accomplished such as volume of quantity (Cut & Fill), Bituminous Wearing Course, Bituminous Base Course, Bituminous Prime Coat, Sub-grade, and all structures completed for our Monthly Payment Certificate (Monthly Billing).
- Coordinate to the assign consultant from time to time in order to update what is their requirements, problems so that immediate action will be provided.
- Prepare Bar Chart Schedule in order to monitor the on-going project if the project is substantially done according to schedule.

December 1998 – December 2000

Firm : Rabiah & Nassar Co.
Riyadh, Saudi Arabia
Position : Civil Engineer

Duties and Responsibilities:
- Evaluate daily work accomplishment of contractor's activities.
- Review monthly progress and final invoices, and variation orders and forward recommendation to client.
- Monitor on-going projects according to approved construction schedule.
- Field supervision and inspection of on-going construction works, to determined if work is proceeding in accordance with the contract documents and approved drawings and specifications.
- Prepare project schedule using MS Project Software.
- Records all in-coming inquiry for price quotation (bidding) and send follow up letter for the quotation submitted to the contractor/client in order to know the latest information of the project.
- Helping in developing forms & office procedure using Microsoft Excel & Microsoft

Word.

September 1992 – December 1998

Firm : Saleh & Abdulaziz ABAHSAIN Co., Ltd.
Riyadh, Saudi Arabia
Position : Civil Engineer / Computer Programmer

Duties and Responsibilities:

- Responsible for all in coming and out going works in Engineering and Computer Section.
- Compute earthworks quantity, grade line elevation and inputs all data in computer to produce cross-section printouts.
- Monitoring all the progress of all on-going projects in the Airbase (Pannesma Project). Collect all necessary documents i.e., Daily reports, mobilization, demobilization instruction for all equipments used and invoices for the preparation of our monthly billings.
- Update and computerize all reports submitted by field offices and produce cross-section printouts to submit with the consultant for final payments.
- Supervised the running and maintenance of operational computerized system.
- Determined programming requirements and design initial input/output formats:
- Make a program as management and users require using DBASE III Plus/FoxBase
- Modify existing program as per instruction of the users and the management.
- Monitoring all operational computerized system in field offices and helps them to update and develop some new ideas in computer system.

June 1991 – June 1992

Firm : Abdulla B. Al-Khalifa & Sons Company
Al-Khobar, Saudi Arabia

Position : Civil Engineer / Computer Engineer

Duties and Responsibilities:

- Determined programming requirements and design initial input/output formats.
- Coordinate with other user department/office in the implementation of operational computerized systems.
- Prepared work schedule using MS-Project Software.
- Update and computerized all weekly progress report submitted by field offices.
- Documents developed computerized systems for future references.

July 1986 – May 1991

Firm : National Irrigation Administration
Communal Irrigation Project & Communal Implementation
Development Irrigation Project)
Quezon City, Philippines

Position : Project Evaluator

Duties and Responsibilities:

- Evaluate works accomplishment of contractor's activities.
- Evaluate bid proposal, cash flow, bar chart and Pert CPM for the construction of infrastructure projects.
- Analyzed and control of project cost and construction cost accounting.
- Check billing amount submitted by the contractor, evaluate accomplishments and analyzed thereof.
- Made visit to construction site and determined if work in proceeding is in accordance with the contract documents.
- Conducted inspection to determine if the project is substantially completed and final inspection to determine if the work had been completed in accordance with the contract document and the contractor has filled all his obligations so that final payments are made to the contractor.
- Input's data of monthly accomplishment of communal irrigation projects based on monthly coded report in the computer.
- Prints the output of the computer on evaluation of project physical and financial accomplishments.

SEMINAR/TRAINING:

COURSE	:	Monthly Seminar on Crop Diversification
HOURS	:	12 HOURS
DURATION	:	August – November, 1990
SPONSORED BY	:	National Irrigation Administration & Japan International Cooperation Agency Tokyo, Japan

COURSE	:	Leadership Training Seminar
DATE	:	January 24, 1990
SPONSORED BY	:	Polytechnic University of the Philippines Sta. Mesa, Manila

EDUCATION:

ELEMENTARY	:	Concepcion East Central School Caluluan, Concepcion, Tarlac	: 1971 – 1977
SECONDARY (High School)	:	Elpidio Quirino High School Bacood, Sta. Mesa, Manila	: 1977 – 1981
COLLEGE/ UNIVERSITY	:	Polytechnic University of the Philippines Sta. Mesa, Manila (Bachelor in Civil Engineering)	: 1981 - 1986

POST BACCALAUREATE COURSE:

	:	Polytechnic University of the Philippines Sta. Mesa, Manila (Computer Technology)	: 1989 – 1990

PERSONAL DATA:

NAME	:	LAURO M. MALONZO
ADDRESS	:	Block 7 – Lot 14B, Don Juan Bay View Subdivision, Sucat, Muntinlupa City
NATIONALITY	:	Filipino
DATE OF BIRTH	:	11 August 1964
BIRTH PLACE	:	Concepcion, Tarlac, Philippines
RELIGION	:	Christian
CIVIL STATUS	:	Married
NO. OF CHILDREN	:	Two (2)

Rolly Guanzon Manalang
50 Rizal Guagua Pampanga, Philippines
Contact #. +965-6641802 / 6814215
Email add: rollygm@yahoo.com

Objective:

A position in an oriented company that seeks an ambitious career conscious person, where acquired skills and education will be utilized toward continued growth and advancement.

Educational Attainment:

Tertiary

Bachelor of Science in Mechanical Engineer
Don Honorio Ventura College of Arts and Trades
Bacolor, Pampanga Philippines
Year: 1998 – 2003

Secondary

Guagua National Colleges
Guagua, Pampanga Philippines
Year: 1994 – 1998

Primary

Rizal Elementary School
Guagua, Pampanga Philippines
Year: 1989 – 1994

Work Experience:

Boiler & Waste Water Treatment Maintenance
Universal Robina Corporation
San-Fernando Pampanga Philippines
June 2004 to October 2004

Current Job:

Technical Engr. & Internal Evaluator (TSM
Toyota Customer **S**ervice **M**arketing**)**
Mohamed Naser Al-Sayer & Sons Est. Co.
Toyota Kuwait
March 2005 – Till Present

Personal Data:

Date of Birth	:	December 30, 1981
Place of Birth	:	Lubao, Pampanga Philippines
Age	:	26 Yrs old
Nationality	:	Filipino
Religion	:	Catholic
Civil Status	:	Single
Height	:	5’8”
Weight	:	135 lbs.
Language	:	Tagalog, English, slight Arabic

Computer literate especially in **AutoCAD 2D & 3D** and with **International Driving License**.

Student member in Philippines Society of Mechanical Engineers (P.S.M.E.) Since 16th of February 2000

Personal Attribute:

>Motivated self-starter with an attitude for learning new skills quickly.

>Recognized for high ethical standards in all worked performed.

>Effectively motivate other on all levels in achievement of individual and organizational goals.

>Talented and determined individual who accomplishes results.

>Maintain composure under pressure able to work autonomously with little direct supervision.

Seminars & Training Attended:

Industrial Lubrication & Heating, Ventilating and Air-Conditioning
February 16, 2001

Metrology and Steam Boiler Operation and Maintenance
January 17, 2002

Pneumatics and Power Plant Lubrication
January 30, 2003

Body Alignment & Welding
August 27 – 31, 2005

Computerize Measuring Chassis System NAJA
December 24 – 26, 2005

Automotive Glass Bonding
March 26 – 27, 2006

Body Shop Management Course
April 4 – 5, 2006

Color Matching
December 2 - 6, 2006

Toyota Customer Service Marketing (TSM)
December 9 – 14, 2006

Top Coating Course
May 12 - 16, 2007

I hereby certify that the above information are true and correct to the best of my knowledge and ability.

Rolly G. Manalang

Martin Nodado Mejorada

Address: P.O. Box 29730, Safat, 13158 State of KUWAIT
KUWAIT Mobile: +9659135686
E-mail: martey_m@yahoo.com

PROFESSIONAL QUALIFICATION

DESIGN / MECHANICAL ENGINEER

Personal Data

Gender:	*Male*
Date of Birth:	*April 25, 1973*
Civil Status:	*Single*
Nationality:	*Filipino*
Passport No.:	*KK 949259*

Employment History

Company: LEE DYNAMICS INTERNATIONAL
Address: Ardiya, Kuwait
Date Employed: October 2006 – Present
Position: **Mechanical Design Engineer**

- Addresses the mechanical designs of components required to mount communication systems to combat support and tactical vehicle systems.
- Performs analyses on strength of materials, materials selection, and preliminary produce ability.

Company: SPECIALIST OILFIELD SERVICES, K.S.C.
Address: Al Ahmadi, Kuwait
Date Employed: March 2006 – October 2006
Position: **CAD Engineer (Mechanical / Structural)**

- Co-ordinates all mechanical drawings carried out from the project site.
- Drafts CAD detailed drawings of machinery and mechanical devices, indicating dimensions and tolerances, fasteners and joining requirements, and other engineering data.

Company: WYETH PHILIPPINES, INC.
Address: Cabuyao, Laguna, Philippines
Date Employed: March 2005 – March 2006
Position: **CAD Engineer (Project Engineering Dep't)**

- Designs, develops and co-ordinates the installation, maintenance and operation of existing onsite equipment.
- Develops 3D detail drawings for construction of equipment and structures, compressor stations, frame, steel, and masonry buildings, piping manifolds and pipeline systems.

Company: PRECISION DRILLING SERVICES MIDDLE EAST
Address: Mussafah, Abu Dhabi, United Arab Emirates
Date Employed: March 2004 – June 2004
Position: **Drill Pipe / Motor Engineer**

- Diagnose reasons of breakdown of drill pipe equipment and carries out necessary repairs in very short time.
- Monitors the checking and repairs of the motors in the event of breakdown.
- Develops CAD detail drawings for manufacture, fabrication, and assembly of drill pipes and machine parts

Company: TAISEI CORPORATION
Address: Al Mirfa, Abu Dhabi, United Arab Emirates
Date Employed: December 2003 – March 2004
Position: **Assistant Electrical Commissioning Expeditor (Project: Shuweihat Transmission)**

- Commissions all the onsite equipment and performs site surveys of existing installations.
- Ensures project deliverables are completed in a timely and accurate manner.
- Drafts plans and drawings for layout, construction, and operation of pipeline systems from field notes, rough or detailed sketches, and specifications.

Company: STAYFAST PHILIPPINES, INC.
Address: San Pedro, Laguna, Philippines
Date Employed: September 1998 – November 2003
Position: **Technical / Fabrication Supervisor (Machine Shop)**

- Supervises the fabrications of machine parts and tools in accordance with the approved specifications.
- Oversees and monitors the repairs and maintenance of tools and machine parts.
- Ensures that all machines are maintained in good working condition and all worn out parts are replaced.

Position: **CAD Mechanical Drafter**

- Reviews rough sketches and engineering specifications.
- Drafts multiple-view assembly, subassembly, and layout drawings as required for manufacture and repair of machines and equipment.

Company: NIDEC PHILIPPINES CORPORATION
Address: Sta. Rosa, Laguna, Philippines
Date Employed: December 1997 – June 1998
Position: **Production Line Engineer**

- Continuously evaluates man, machine, materials, and method to maximize productivity and improve efficiency and quality, thus reducing wastage and production cost.
- Monitors all quality records, special production processes at all times.
- Maintains 3Q6S Principle and ensures that all operation activities are done according to specifications.
- Provides effective counter-measure in case of non-conformance.
- Trains new operators, designs and implements programs for continuous cross-training programs.

Position: **CAD Mechanical Design Detailer**

- Drafts CAD detailed drawings of parts of machines or structures from rough or general design drawings.
- Shows dimensions, material to be used, and other information necessary to make detailed drawing clear and complete.
- Makes tracing of finished drawing on semitransparent paper from which blueprints can be made.

Company: DENTAL SYSTEM CORPORATION
Address: Parañaque City, Philippines
Date Employed: May 1996 – August 1997
Position: **CAD Mechanical Design Engineer**

- Prepares detailed CAD working diagrams of machinery and mechanical devices, including dimensions, fastening methods, and other engineering information.
- In charge of assigning, directing, & inspecting the work updates on the prototype.
- Examines and inspects materials and finished parts and products for defects and wear and to ensure conformance with work orders, diagrams, blueprints, and template specifications.

Educational Background

College: **MAPUA INSTITUTE OF TECHNOLOGY** 1996
Intramuros, Manila, Philippines
- ***BS MECHANICAL ENGINEERING***

Technical: CRESCENT TECHNOLOGIES, INC. 2006
Pasig City, Philippines
- ***Computer-Aided Design of HVAC Systems***

CRESCENT TECHNOLOGIES, INC. 2006
Pasig City, Philippines
- ***Computer-Aided Construction Project Management***

MICROCADD TECHNOLOGIES CO., INC. 2005
Quezon City, Philippines
- ***Autodesk INVENTOR PROFESSIONAL 9***

CIM TECHNOLOGIES, INC. 2004
Makati City, Philippines
- ***AUTOCAD 2004 2D/ 3D-Modeling***

TESDA/NFE-LAGUNA 2004
Sta. Rosa, Laguna, Philippines
🗁 ***Consumer Electronics Mechanics***

SAN PEDRO MANPOWER TRAINING CENTER 2003
San Pedro, Laguna, Philippines
🗁 ***Electrical Wiring Systems & Designs***

SAN PEDRO MANPOWER TRAINING CENTER 2002
San Pedro, Laguna, Philippines
🗁 ***Automotive Mechanics (Gas/Diesel)***

INTERFACE COMPUTER COLLEGE 1997
Quiapo, Manila, Philippines
🗁 ***AUTOCAD 2D/3D***

Special Trainings

🗁 Manual Handling (*Abu Dhabi, UAE*)	June 2004
🗁 Basic First Aid & CPR (*Abu Dhabi, UAE*)	June 2004
🗁 H2S & BA (*Abu Dhabi, UAE*)	May 2004
🗁 PCO Accreditation Seminar (PCAPI)	May 1999
🗁 ISO 9000/9002 Awareness Seminar	March 1998
🗁 The HONDA VTEC	March 1996
🗁 Fundamentals of Air Conditioning	February 1996
🗁 Personality Development	February 1996
🗁 Cogeneration on Diesel Power Plants	January 1996
🗁 Industrial Safety	January 1996
🗁 Computer Concepts	March 1990

Computer Skills

- 🗁 AutoCAD 2004/2005/2006 (2D/3D Modeling)
- 🗁 Hourly Analysis Program (HAP) v4.1
- 🗁 Duct Design v3.27
- 🗁 Primavera Project Planner v3.1
- 🗁 Autodesk INVENTOR Professional 9
- 🗁 Autodesk REVIT BUILDING 8
- 🗁 Autodesk VIZ, 3D Studio Max, and MAYA
- 🗁 Microsoft Office: Word, Excel, & PowerPoint
- 🗁 Hardware/Software Installation and Troubleshooting
- 🗁 Internet and Networking
- 🗁 Desktop Publishing

Special Skills

- 🗁 Machine Shop Practice
- 🗁 Drafting and Design
- 🗁 General Works / Maintenance & Repairs
- 🗁 General Supervision & Management

References

Ms. Yvonne T. Gentolia	Senior CAD Instructor c/o MICROCADD Technologies Co., Inc. Makati City, Philippines	+63921-8187091
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OBJECTIVE

Innovative Project Management Professional seeks position in which aggressive prospecting, precise negotiation, and excellent communication skills combine with extensive program management and for exceptional leadership in operations.

SUMMARY

Qualified by 23 years of military, government, and private sector experience demonstrating the following competencies and behaviors:

• Business Acumen	• Operations Management
• Business Development	• Proposal Development
• Project Management	• Contract Negotiation
• Interpersonal Skills	• Military Customs and Courtesies
• Financial Analysis	• Staff Mentoring
• Teamwork	• Leadership

ACCOMPLISHMENTS

- Managed Proposal, Award, and Implementation of Major Government Contracts (1 - 600 Million USD)
- Master of Business Administration, ***Darden School of Business***, University of Virginia
- Graduate, WV State College. Dual Major of Economics (BS) and Political Science (BA)
- Managed new car inventory and ordering for multi-line dealership
- Presented and sold various automotive product lines to retail, fleet, and corporate clients
- Sales Leader in both new and pre-owned lines
- Combat Leadership and Command roles in Operations Just Cause, and Desert Shield/Storm
- Commissioned as a 2LT in the US Army 1986

PROFESSIONAL EXPERIENCE

RAMIN General Trading & Contracting,WLL *KFTZ, Kuwait* **2005 – Present**
Program Manager, Military Operations Kuwiat/Iraq
Government Contract Manager
Proposal Consultant and Solicitation Project Manager

PWC Logistics, Safat, Kuwait **2004 - 2005**
Business Development Manager

International Profit Associates, Chicago Il **2003 - 2004**
Senior Business Analyst

Atlanta Auto Search, Atlanta, GA **2002 – 2003**
Vice President – Luxury/Exotic

Carriage House Imports, Atlanta GA **2001 - 2002**
Mercedes – Benz Sales Consultant
Certified Product Specialist 2002 – Cars/Light Trucks

Mercedes Benz – North America, Montclair, NJ **2001 - 2001**
Product Specialist, American Market Passenger Cars
Model Year 2002 Product Launch Team

Eller's Auto Exchange, Charleston, WV **1999 - 2001**
Pre – Owned Sales Manager
Finance Manager
Sales Consultant

Moses Automotive Network, Charleston, WV **1998 – 1999**
Inventory Manager
Sales Executive – Cadillac/Buick
Certified Product Specialist – Cadillac/Buick

Smith Company Motor Cars, Charleston WV **1996 –1998**
Sales Executive – Mercedes – Benz

Moses Automotive Network, Charleston, WV **1994 – 1996**
Fleet/Commercial Sales Consultant

United States Army **1986 – 1992**
Company Commander
Company Executive Officer
Briefing Officer

EDUCATION

University of Virginia, Darden School of Business Charlottesville, VA **1994**
Master of Business Administration

West Virginia State College, Institute WV **1987**
Bachelor of Arts, Political Science
Bachelor of Science, Economics

Local inventor gets technology award

By NADIA WHITE
Star-Tribune staff writer

CASPER — Seven years after Neal Miller started working on a better way to clean up oil field waste, his newly-patented three-phase centrifuge technology has been heralded as one of the year's most technologically significant new products.

R&D Magazine of Des Plaines, Ill., awarded Miller an R&D 100 Award -- the Nobel Prize of applied research — for his machine and the process by which it works. The award is given to 100 of the most technologically significant new products and processes of the year, according to a release from the magazine.

Miller and his centrifuge are in good company — past technologies that received the award include the electronic video recorder (1969), anti-lock brakes (1969), the automated teller machine (1973), halogen lamps (1974) the fax machine (1975) and the Nicoderm transdermal patch (1992).

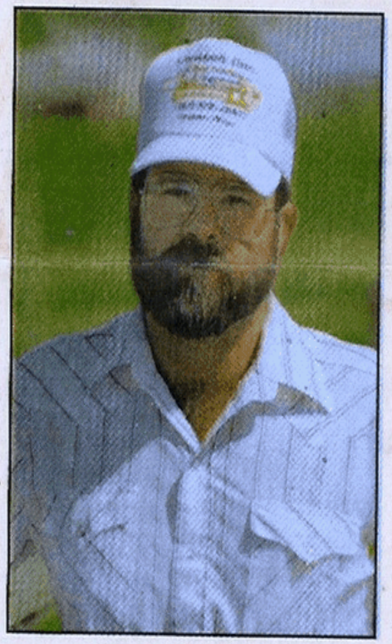
But he's not getting too carried away over the award. "I don't get a big head about anything, but it's a lot bigger deal than I'm aware of," Miller said. "I just know we worked really hard on this for quite a few years and it took awhile to get my patent on it, maybe one of these days it'll pay out."

The three-phase centrifuge technology is the only service currently offered by Miller's firm, Centech, Inc. of Casper, he said.

The treatment process is the most environmentally sound means of separating out a wide range of oil and water blends into more easily disposed of parts, said Miller, it's inventor.

It works by subjecting oil and petroleum waste, along with added water, to "gravitational forces."

"The three phases" — solids, petroleum products and water —



NEAL MILLER
Invention cleans up oil field waste

"are subjected to gravitational forces and there are certain things you have to do to the design to compensate for what you're putting in it, different settings for different fluids," Miller said.

The result, he said, is that a variety of wastes — often mixed into an oil sludge — are broken down into more easily disposed of parts.

"You can sell your oil. We make, in almost all cases, pipeline grade oil out of this trash," Miller said.

The water and solids are more easily disposed of separately than mixed together.

Only one three-phase centrifuge machine has ever been built, Miller said. He received a patent for it in the fall of 1992.

It's fully mobile — if you've got a semi to pull the 40-foot lowboy trailer it's mounted on — and has been used in a variety of remote locations to clean up oil waste pits, oil field and refinery work sites and oil and diesel fuel spills.

The process also works to clean up the gunk that accumulates in the bottom of oil storage tanks and has proven successful when other remediation efforts failed.

Miller described his operation as a kind of Boots and Coots of the centrifuge world. "People don't call us unless it's the worst and nobody else can do it," he said.

"A lot of the stuff we get a hold of has already been processed a number of times. A lot of people have really heated stuff up and treated it with heavy chemical use. We don't ever get anything good to do it seems like. And we make line oil out of that crap."

Furthermore, he said, further design changes and testing was showing the process worked to separate a variety of chemical contaminants beside petroleum products.

Miller's work developing the centrifugal process was financed by local people, including Herb Tholl, Sam Miller, Bob Cundy, Opal Lacey and Herschel McClure, he said

The business side of things has been helped along by the Small Business Development Center, he said.

"I'm not geared to be a business person. I'm more happy sitting in the field, running equipment, and dreaming things up and building stuff than I am sitting at a desk doing paper work. But it all comes with it," he said.

Miller said he has no idea what comes along with getting the R&D award, other than an award presentation and three-week exhibit at Chicago's Museum of Science and Industry.

"The only thing I know is they're wanting a suit-and-tie affair at the awards ceremony and I'm not geared to no suit and tie. If I showed up they may not let me in the door anyway," Miller said.

Star / Casper Area, Section C
Thursday, June 17, 1993

eye on business

'Spin doctor'

... salvaging fuel from sludge

By JASON MARSDEN
Star-Tribune staff writer

CASPER – Think of it as a giant spin cycle for oil sludge.

From the simple inspiration of a washing machine – and the proverbial 99 percent perspiration – was born Casper inventor Neal Miller's patented centrifuge process for salvaging pipeline-quality oil and clean water from goo the industry used to just bury.

In the three years since winning a coveted R&D Magazine R&D 100 award – the Nobel Prize of applied research – Miller has computerized his modest-looking trailer-mounted device with the help of the U.S. Energy Department's laboratory in Los Alamos, N.M.

Now a pair of conservationist authors has named the oilfield-hand-turned-eco-entrepreneur one of the nation's "Environmental Heroes."

In their new book of the same name, Gary Chandler and former Star-Tribune correspondent Kevin Graham laud Miller's 10-year-old company, Centech, for recovering fuel that otherwise would be wasted, and thereby decreasing environmental contamination.

For the plain-spoken Miller, who seems a bit bemused by all the attention, it's just what he does.

Miller, whose formal education ended with high school, studied a German engineering process that led him, through trial-and-error and with the support of some local shareholders, through a seven-year buildup to the award from R&D Magazine.

Now he's in the running for another R&D award – this time jointly with Los Alamos National Laboratory, which built a computer system into the newest generation of centrifuge, and wrote software based, Miller said, "on what goes on inside my head.

"It sounds kind of scary to me," he says with a laugh. But he's found it works, through field testing at the U.S. Navy's Rocky Mountain Oilfield Testing Center at the Teapot Dome field in northern Natrona County.

Where others have failed

Miller's company is often called in to deal with cleanups others have tried and failed, he said Monday in his cavernous shop off Salt Creek Highway.

Sludge that accumulates in pit bottoms, storage tanks and from refinery waste, Miller said, often is heated or doused in solvents in attempted cleanups – only to end up a bigger mess than before.

Photos by TRICIA McINROY/Star-Tribune

Top: Neal Miller sits with his dog, Moose, on centrifuge equipment used to separate salvageable oil and water out of sludge that accumulates in production and refining.

Above: an example of the waste Miller works with, taken from a refinery in Texas.

In Bell jars and paint cans near the door, Miller has a collection of samples you need to see to believe. Some are solids suspended in smelly fluid; some are black and slushy, like old paint. One is as shiny as black vinyl and so sticky the jar won't open.

Companies that used to bury the stuff increasingly find regulations won't allow it, and those that used to pay to have it trucked to far-away disposal facilities are increasingly afraid of the potential liability should it spill in transit, he explained.

So Miller tows his 40-foot trailer to their site, heats it enough to pump it into the centrifuge, then spins it at a predetermined RPM depending on the substance.

Oil and water separate out depending on their weight and drain into separate tanks. Vapors are filtered through a series of baffles, collecting the chemicals that condense while dispelling steam into the atmosphere.

Solids remaining – iron sulfide, sand, dirt – are often benign enough to be buried in a landfill, though occasionally regulations require hazardous-

Please see SPIN DOCTOR, C2

HART'S

OIL and GAS WORLD

REGIONAL COVERAGE OF U.S. EXPLORATION, DRILLING AND PRODUCTION

Centrifuge separation system cleans tank bottoms and other oilpatch wastes

In most cases, an operator can't make money by using a centrifuge on tank bottoms, but it can save disposal costs.

A group of companies cleaning up an oilfield reclaiming facility near Casper faced a common oilpatch problem: Crude oil below pipeline quality could represent a liability.

The facility contained some 25 Mbbl of the material in underground tanks, above-ground tanks and pits.

The companies put out bids to six environmental contractors, and the best any of them could do was promise 1% impurities in the recovered oil. That's not good enough for pipelines.

The solids will be thermally treated at the site.

In another situation, Cenex of Billings had an oilfield near Thermopolis, Wyo., at Murphy Dome, with 800 bbl of "slop oil and tank bottoms, including 300 bbl in a tank that we had tried to treat," says Jeff Casey, environmental engineer.

A couple of the tanks had been around forever, he added, and Cenex had to bring hot oil trucks out to get it liquid enough to pump.

It recovered 300 bbl of salable oil, some treatable water and 20 to 30 cubic yards of solids that await further action.

Normally, when a producer has to get rid of bottoms, there are few options. It's hard to impossible to find someone to haul them away. Most operators try land farming or on-site bioremediation. Around Casper, Neal Miller at Centech Inc. offers another option.

Miller has a three-stage centrifuge that he uses to separate solids, oil and water, often to conditions clean enough that the operator can spread the solids and water on the ground and sell the pipeline-quality oil.

This is a continuous-flow centrifuge, a more complicated version of the system that controls solids on a drilling rig. Picture a screw drive inside a pipe tapered at one end.

Miller feeds the tank bottoms through the central shaft. The spinning outside pipe separates solids from water and oil from both of the other substances.

The screw drive pushes solids to the tapered end of the machine where they are discharged to outer cases and then to storage.

At the other end, the separated water form pools at different levels and exit from separate overflow outlets in the case.

The oilfield version of this centrifuge contains some proprietary additions that have earned Miller one patent and may earn more in future versions.

Because the system works, Miller tends to get the dirty jobs. "The stuff we get and run is stuff people have been trying to work with for years tank bottoms, pit sludge, treater residue," he says.

He pulls up to the site with a 40-foot low-boy rig and runs the whole works from the buttonhouse. The request is the same everywhere. Everyone wants pipeline grade oil out of trash.

"We ask them to put the feed stock in tanks. We pull it out of the tanks, through a heater if needed, into the centrifuge.

"We discharge the solids, and sometimes they can land farm or land fill with them," he says.

"We catch the water and oil in catch tanks, and we can pump it anywhere the customer wants it," he says. Usually the oil goes into tanks. Sometimes the water goes into a waterflood.

The speed of production is about like that of a decent well, depending on oil-water ratios. "The bottoms only split so fast, and everything we've done has been sitting around for 10-12-20 years. I like to tell people I can shoot for 100 bo/d," he adds.

In mid-December, in the Powder River Basin near Casper, he was running BS&W (officially called basic sediment and water, but the oilfield terminology is less formal), and got the impurities in the oil down to .2%. That's pipeline quality.

"Neal can do exactly what he says he can do. Neal's the only one who could give us pipeline quality oil," says The True Cos. Renee Taylor, who has used Miller on a project for Black Hills Trucking, a True company.

Casey says his company probably broke even using Miller's treatment, compared with hauling and disposing. But, he adds, "We weren't prepared for the high hot-oil costs."

Essentially, the goo was so thick, the company had to keep the hot-oil truck on hand throughout the separation project.

If a situation came up again where Miller's treatment might solve a Cenex problem, "I would definitely consider using it again," Casey adds.

In separating the components, Miller tries to get the solids to landfill quality.

The daily rate varies with setup, regulatory and safety requirements. The range is $850 to $1800. The per-barrel cost varies with volume and product. On past jobs, that has ranged from $4.25 to $17/bbl.

On one job where the operator made money, the product was BS&W. There was no chemical problem to fight. He was able to run 200 bo/d, and they got 20% more oil than they thought they would.

Typically, he goes out on jobs that require processing of a minimum of 600 to 800 bo; projects from smaller operators. But, he has worked for larger producers as well.

Recently, the process has gotten more notoriety and more help toward becoming a full-fledged operation with potential for cleaning up the oilfield environment at lower expense.

Miller's three-phase centrifuge and process made the top 100 in the *R&D* magazine awards for 1993.

And, over the past couple of years, he got a team of oilfield research professionals and an engineering powerhouse on his side.

The research professionals are at New Mexico Institute of Mining and Technology in Socorro, and the powerhouse is Los Alamos National Laboratory.

Jerry Parkinson, an adjunct professor at New Mexico Tech and a Los Alamos engineer, said Bob Bretz and New Mexico Tech called him about the process and its potential, and a former student worked with Miller and was impressed with the process and its results.

They set up a demonstration project at Unichem Inc.'s Parabo disposal site outside of Hobbs. With the help of a Rio Tech grant, they put together enough money for two months of work and brought Miller down.

In New Mexico, the process didn't work as well because of high levels of solid hydrocarbons in the mix. Still, on average, the product had less than 1% BS&W in the hydrocarbons, and the water had very low levels of dissolved hydrocarbons and small amounts of filterable solids.

At that research project, where some of the services were donated or provided at bargain rates, the New Mexico Tech and Los Alamos people put together some numbers. From an economic point of view, on a three-day test, they produced 119 bo of salable oil. That earned $2500 when oil prices were $21/bo. And, they avoided $720 for the disposal of 360 bbl of tank bottoms at $2/bbl. Total on the positive side was $3220.

On the cost side, Miller charged only $750 a day for three days. He asked only a $2/bo throughput charge. He rented a generator at $125 a day and the generator used $150 worth of fuel. Total on the cost side was $3495.

Another gain came out of the study, as well. Since Los Alamos thought this was a good project, it began working on ways to make it better.

Miller's knowledge and occasional seat-of-the-pants moves make the system work.

Los Alamos is trying to create an artificial seat. It's working on an system that synthesizes Miller.

For instance, it will ask an operator for the makeup of the tank bottoms and recommend feed and other parameters, such as the speed at which to feed the mix into the centrifuge and the speed at which the centrifuge turns.

TODAY'S REFINERY

March 1995

Serving the Worldwide Petroleum Refining Industry

Refining Details

Art Gardner

Clean Oil, Clean Water, Clean Solids

Refiners have been focusing more efforts on upgrading heavy, sludgy, dirty oil not just for environmental reasons but also for profit. In November 1991 we discussed processing used motor oil in a Refining Details article entitled "Make Old Oil Like New". Some refiners add small amounts of waste oil to coker charge, while monitoring product quality and adjusting waste oil content to retain on spec product. Desalting crude has been a source of waste oil in the form of emulsions, which have to be periodically removed from some refinery desalters. One source of waste oil familiar in many refineries is tank bottoms, particularly from crude tanks. Asphaltenes, suspended solids, and oxidized hydrocarbons make up a good part of tank bottoms, which gravitate to the bottom when left unagitated.

A CENTRIFUGE: So, FRRPS (Fictitious Roving Refinery Problem Solver) became excited, when a report from a technology foundation, which rented a centrifuge to study economics of separating crude production tank bottoms, appeared concerning separating heavy, sludgy, dirty oil into clean oil, clean water, and clean solids at a profit. The petroleum industry has seen many centrifuge projects tried but fail the industry's tests. Why should this one be any different? FRRPS discovered that (1) operation of a particular centrifuge of unique and proprietary design has been responsible, since 1986, for providing several families with satisfactory incomes, that (2) during the past year at least as much centrifuge work, as has been accepted, has been turned away, that (3) training technicians to operate this centrifuge successfully requires about one year, and that (4) the centrifuge owner has applied for and received government matching grants for advanced process control technology, such as artificial intelligence (AI), to be applied to the centrifuge operation by engineers at the laboratory that developed United States' atom bomb.

CENTRIFUGE TECHNOLOGY: FRRPS has seen centrifuges come and go in attempts to clean up oily waste materials. About the only place refiners use centrifuges successfully is in phenol processing of lube oils. In this application, phenolic acid is intentionally mixed with lube distillate to remove naphthenic stocks. Heavier phenolic acid and tar are spun out of lube oil stock, which goes to further processing. Acid tar usually becomes burner fuel. This is a simple two phase separation, the operation of which can be improved by adjusting acid-to-lube distillate flow ratio. Waste oil requires a three phase (oil, water and solids) separation but operation cannot be improved by adjusting oil, water and solids mixing, although laboratory analysis can indicate the composition of each. The only control a centrifuge operator has over product quality from waste oil is by adjusting feed rate, feed temperature, and centrifuge mechanical settings. Chemicals are usually not used.

SATISFACTORY INCOMES: FRRPS admits that most centrifuge applications have been with petroleum production tank bottoms in the oil patch and not in refineries. However, refinery tank bottoms have been successfully centrifuged. FRRPS estimates that to manage a service company continuously for six years in the petroleum industry must have required giving some type of successful service to customers. Supporting that judgment are satisfactory results that were documented in the centrifuge report. Also, this centrifuge must be considered proven technology, if people can earn a living providing services through centrifuge operation, with the only reason for paycheck interruptions coming from winter weather, not lack of work.

TURNED AWAY WORK: FRRPS observed that if work has been turned away, there are more

(continued on page 24)

centrifuge applications out there than can be fulfilled by one centrifuge. Of course, some of the turned away work is in Saudi Arabia, Russia, and South America. Perhaps foreign travel not being appealing is the biggest factor in turning some work down. However, environmental agency clean up work having been turned down presents a strong case for investing in at least one other centrifuge. This winter a United States Environmental Protection Agency (USEPA) regulated project is progressing successfully.

TECHNICIAN TRAINING REQUIRES ONE YEAR: FRRPS explains that adding another centrifuge to the operation would require other technicians to operate it and that training a technician to operate successfully requires a year. Refiners are aware of the high cost of training, for which the small business owner of the centrifuge does not have resources. Refiners have employed technology to speed up training time through the use of real time process and control simulations. In the case of the centrifuge, with training being accomplished on the job, when trained technicians are ready to operate another centrifuge, the centrifuge on which they trained no longer will have operators. The small business cannot afford to (1) pay operators during one year of training, (2) pay for accelerated training through process and control simulations, and (3) have the owner spend one year training operators. The key to this catch-22 situation, FRRPS notes, is the alleged complexity of centrifuge operation.

REPORT ON CENTRIFUGE PROFITABLE OPERATION: According to the technology foundation's economic report on production bottoms separation, FRRPS states that seven different petroleum substances were processed by the centrifuge. The substances were obtained, one from a basic sediment and water (BS&W) disposal pit, two from tank bottoms and four from a disposal site, from three types of environments. BS&W in the feed ranged from 4% to 80% and in the oil product from 0.60% to 1.48%, which met 1% average product spec. Overshooting a product spec, as refiners know, is giving money away. Water product contained from 1.6 ppm to 11.6 ppm oil. Solids consisted of from 23.2 % wt to 42.7% wt oil, from 13.0% wt to 39.2% wt water and from 37.6% wt to 45.4% wt dry material. Centrifuge feed could be heated to only 210 F, due to temperature limitations of centrifuge seals. As a result, all paraffins in feed did not liquefy and wax showed up in solids particles product.

ACTUAL FIELD OPERATION: Using the three phase centrifuge under normal operating conditions, FRRPS recounts, oil product, which contains 0.003% to 0.005% BS&W, has been pumped directly into a LACT for pipeline transport. Water product meets industrial sewer specifications. Solids particles product contains 70% to 80% solids and meets product spec and state landfill disposal specifications for nontoxic materials. Oil product contains solids not larger than 3 microns.

THREE PHASE CENTRIFUGE: The centrifuge, FRRPS describes, produces three phases or products, is continuously fed, decants oil and water, and operates at different revolutions per minute (rpm) depending upon the product. There are two moving parts, an outer bowl and a feed tube called a scroll. The bowl has two sections, one is cylindrical, the other is conical and is called the beach. Feed is pumped through the scroll, which extends longitudinally through the narrow portion of the conical section to the wide section of the conical section and through the cylindrical section. Through holes in the scroll, feed is deposited from the center of centrifugal rotation into the bowl near the middle of the centrifuge. Angular velocity of feed from scroll to bowl is determined by arrangement of diverters. Helical flights are mounted on the outside of the scroll or feed tube, which is inside the bowl, forming an auger, which pushes solids up the beach opposite to the feed flow direction. Feed passes through holes, which have been machined into the side of the scroll, into the bowl. The bowl and scroll rotate in the same direction, only the scroll rotates slightly slower so that the auger pushes solids up the conical section of

(continued on page 26)

the bowl or beach, counter to feed flow, through an outlet in the narrow end of the conical section. The auger assists in drying solids by tumbling them up the beach. At the opposite end of the centrifuge in the cylindrical section of the bowl, discharge of both the oil and water are controlled by weirs plates.

CENTRIFUGE OPERATING VARIABLES: Increasing speed increases separation efficiency and wear. Oil and water levels can be adjusted only during centrifuge shut downs, because they require adjusting oil discharge tubes and weir heights. Fortunately, changes in feed composition can be compensated for by varying feed flow rate. If differential angular velocity of the feed from the scroll to the bowl is too high, solids particles will not have sufficient time to settle out of suspension and liquid products will contain solids particles. If differential angular velocity is too low, solids particles will build up in the centrifuge, again leaving solids particles in liquid products. Because solids particles will leave with liquid products during both too high and too low angular velocities, experienced technicians are vital to successful operation. Centrifuge rotational speeds of both the bowl and the scroll as well as the differential rotation speed of the bowl to the scroll are critical to successful operation.

CENTRIFUGE DESIGN VARIABLES: Centrifuge design is not as sophisticated as distillation or heat exchange design, because centrifuge design, while requiring about the same magnitude of empirical information for accurate design, has far less information. As a result we cannot simulate centrifuge operation as successfully as we can simulate distillation or heat exchange operation. Design variables, according to FRRPS, are centrifuge overall length, diameter, length-to-diameter ratio, conical section length, conical section angle, feed inlet position, and materials of construction. Increasing length increases settling time. Increasing diameter increases throughput capacity until separation efficiency drops below design specification due to lower speeds required by safety limitations. Larger diameter bowls cannot rotate as fast as smaller diameter bowls, because safe rotation speed decreases as diameter increases. Increasing length-to-diameter ratio increases settling time. Increasing conical length increases solids particles drying time. Increasing conical section angle also increases solids particles drying time. Change in feed inlet position will change solids particles settling time as well as oil and water residence time.

ADVANCED PROCESS CONTROL TECHNOLOGY FOR CENTRIFUGE: FRRPS knows that refiners are aware that in order to control a process, we have to be able to predict accurately how a change in operation or design will effect product rates and compositions. Hopefully, by modeling centrifuge operation and applying advanced process control techniques, such as AI, will lead to centrifuge simulations and a better understanding of centrifuge design and operating variables.

OTHER APPLICATIONS: FRRPS was impressed that the centrifuge was operated to remove naturally occurring light oil from mined calcium carbonate after crushing and slurring the ore. One notable application of the centrifuge was successfully separating tank bottoms that had not been touched since 1958. A forty foot long trailer transporting the centrifuge has versatile electrical and pumping systems. Although there does not seem to be a need presently to expand capabilities to process higher boiling point paraffins, existing centrifuge seals will have to be replaced to operate at higher temperatures. Removing catalyst fines from catalytic cracker cycle slurry oil and hydrocarbon based solvents from soils are possible applications for centrifuges in which refiners will be interested. ▲

Readers interested in obtaining more information on using centrifuge to clean up refinery waste, contact:
Art Gardner
303-241-6470

US005156751A

United States Patent [19]

Miller

[11] Patent Number: 5,156,751

[45] Date of Patent: Oct. 20, 1992

[54] **THREE STAGE CENTRIFUGE AND METHOD FOR SEPARATING WATER AND SOLIDS FROM PETROLEUM PRODUCTS**

[76] Inventor: **Neal J. Miller**, 920 Lakeview La., Casper, Wyo. 82604

[21] Appl. No.: **691,642**

[22] Filed: **Mar. 29, 1991**

[51] **Int. Cl.**^{5} **B01D 21/26**; B04B 1/20; B04B 3/04

[52] **U.S. Cl.** **210/787**; 210/97; 210/178; 210/360.1; 210/369; 210/378; 210/739; 210/774; 210/781; 494/52; 494/53

[58] **Field of Search** 210/378, 380.3, 381, 210/512.1, 708, 781, 787, 369, 360.1, 178, 774, 97, 696, 739; 494/52, 53, 54, 55, 56

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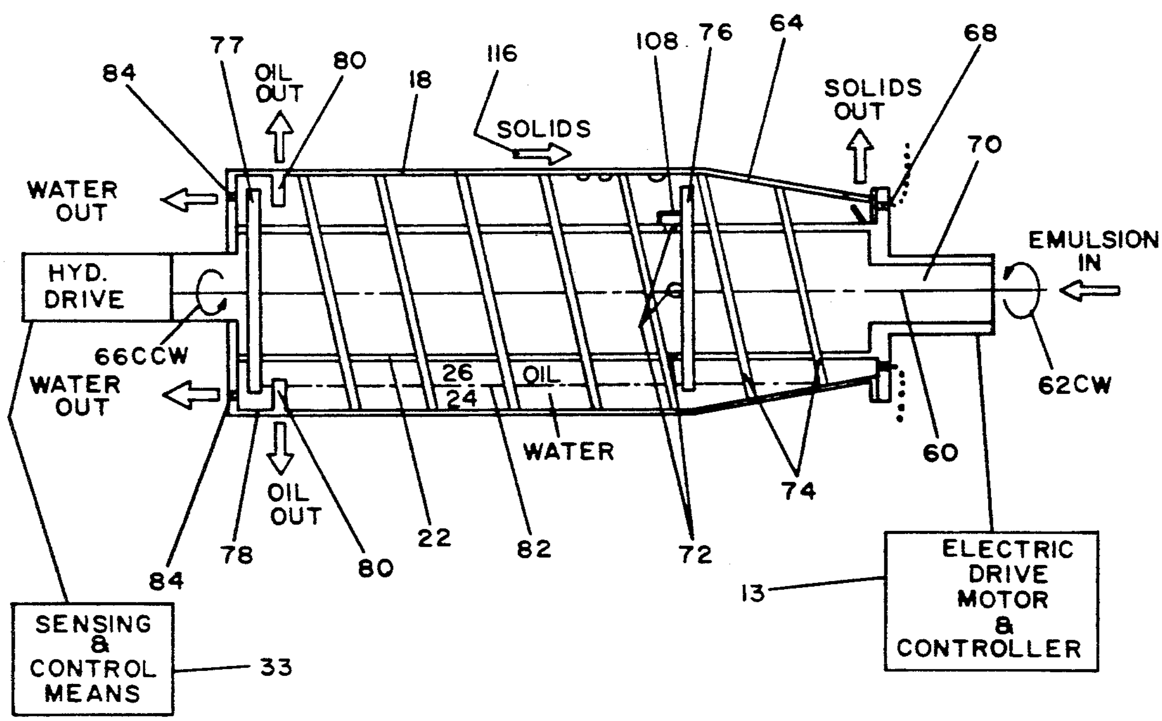
Primary Examiner—Robert A. Dawson
Assistant Examiner—Sun Uk Kim
Attorney, Agent, or Firm—Duane Burton

[57] **ABSTRACT**

A three stage centrifuge especially adapted to the separation of oil, water, and solid particles in an emulsion. As an example, the centrifuge may be used to separate sediment and water from a petroleum product such as crude oil. The three stage centrifuge includes a rotatable bowl that spins the emulsion to separate the fluid oil and water into separate pools within the bowl. The solid particles are also moved radially outward within the rotatable bowl by centrifugal force. A conveyor auger contacts the solid particles and discharges the solids from the rotatable bowl through a solids discharge port. Oil discharge tubes contact the oil pool confined between oil baffle plates on the conveyor auger and allow the oil to be discharged from the rotatable bowl. Water weirs contact the water pool and allow the water to be discharged from the rotatable bowl.

19 Claims, 5 Drawing Sheets



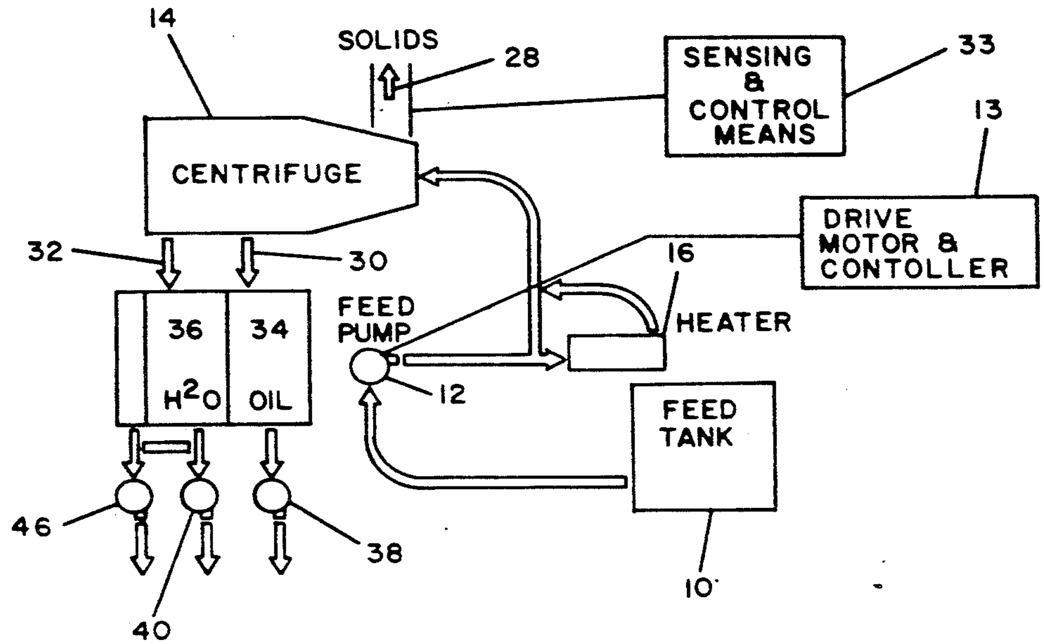


FIGURE 1

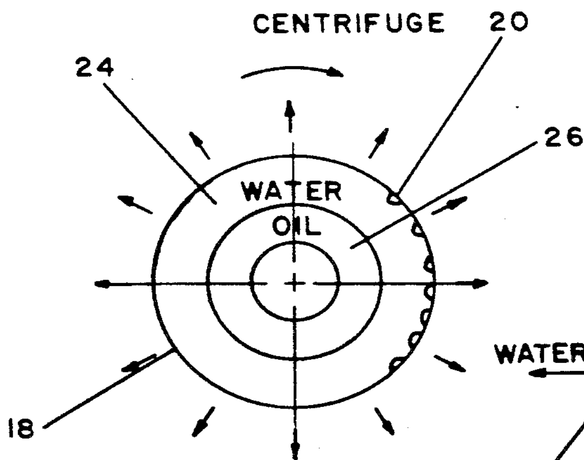


FIGURE 2

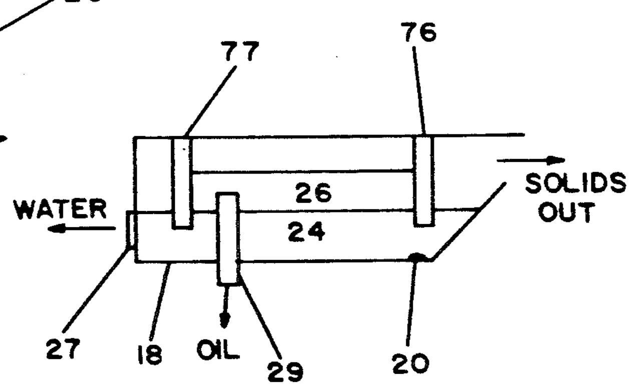


FIGURE 2A

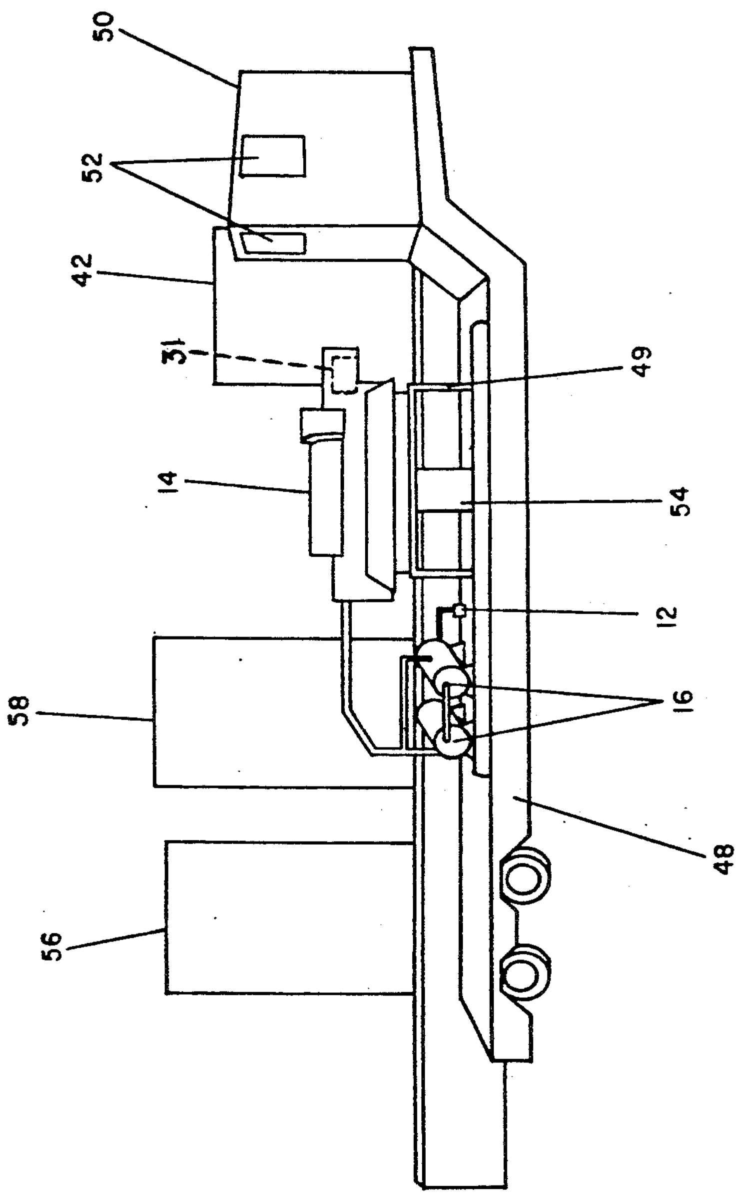


FIGURE 3

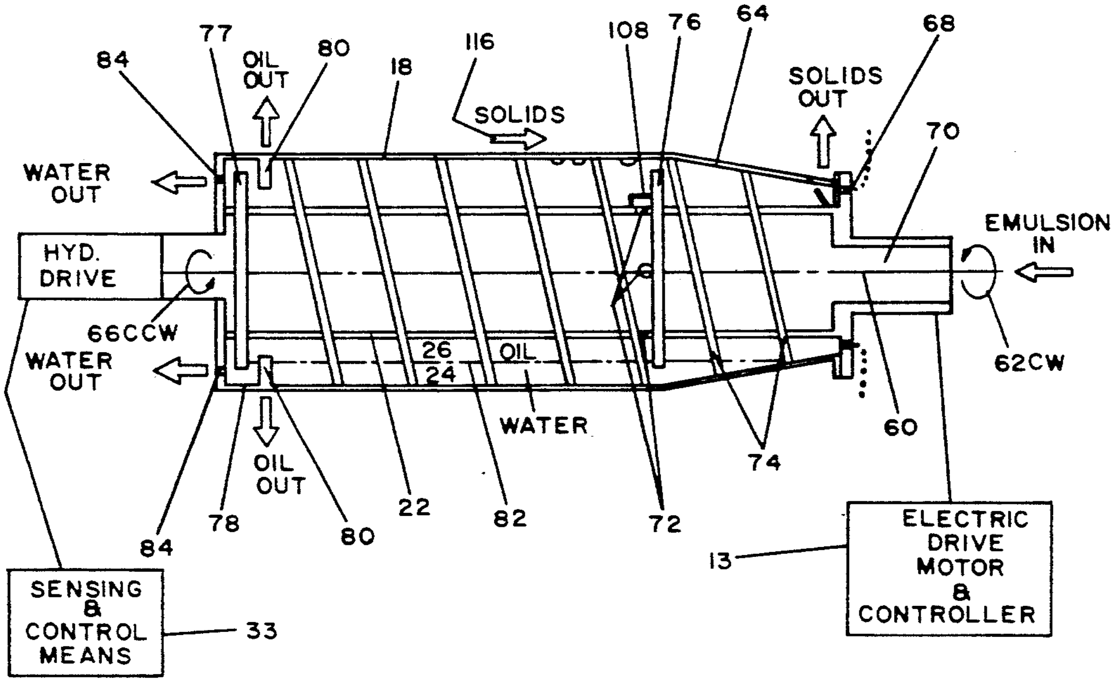

84
77
OIL OUT
80
18
116
SOLIDS
108
76
64
68
SOLIDS OUT
70
WATER OUT
HYD. DRIVE
EMULSION IN
66CCW
WATER OUT
26
24
OIL
WATER
62CW
60
74
OIL OUT
84
78
80
22
82
72
13
ELECTRIC DRIVE MOTOR & CONTROLLER
SENSING & CONTROL MEANS
33

FIGURE 4

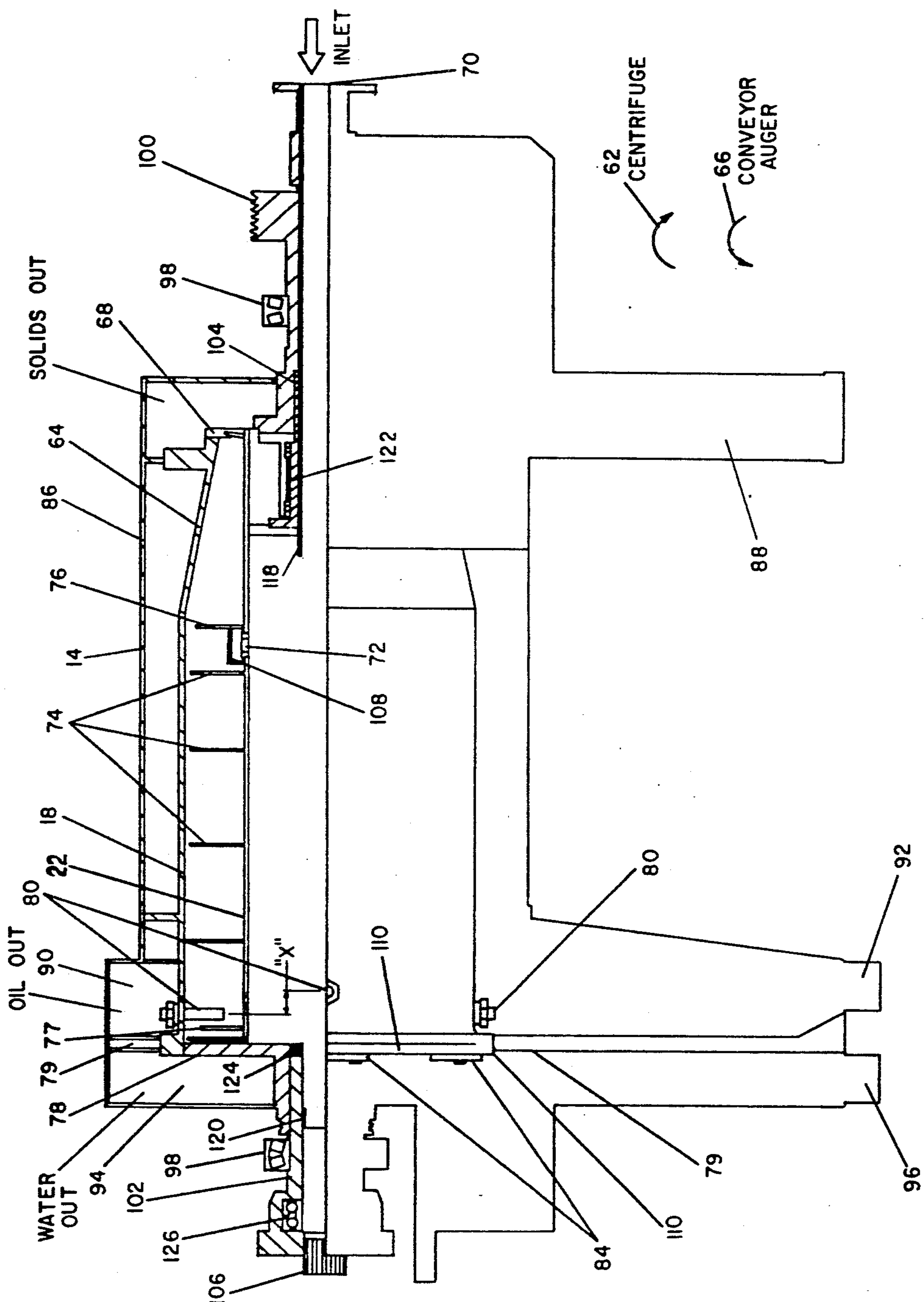

INLET
70
100
98
104
68
SOLIDS OUT
64
86
76
14
72
108
74
18
22
80
OIL OUT
90
77
79
78
WATER OUT
94
124
120
98
102
126
106
122
118
110
62 CENTRIFUGE
66 CONVEYOR AUGER
88
80
92
84
110
79
96
"X"

FIGURE 5

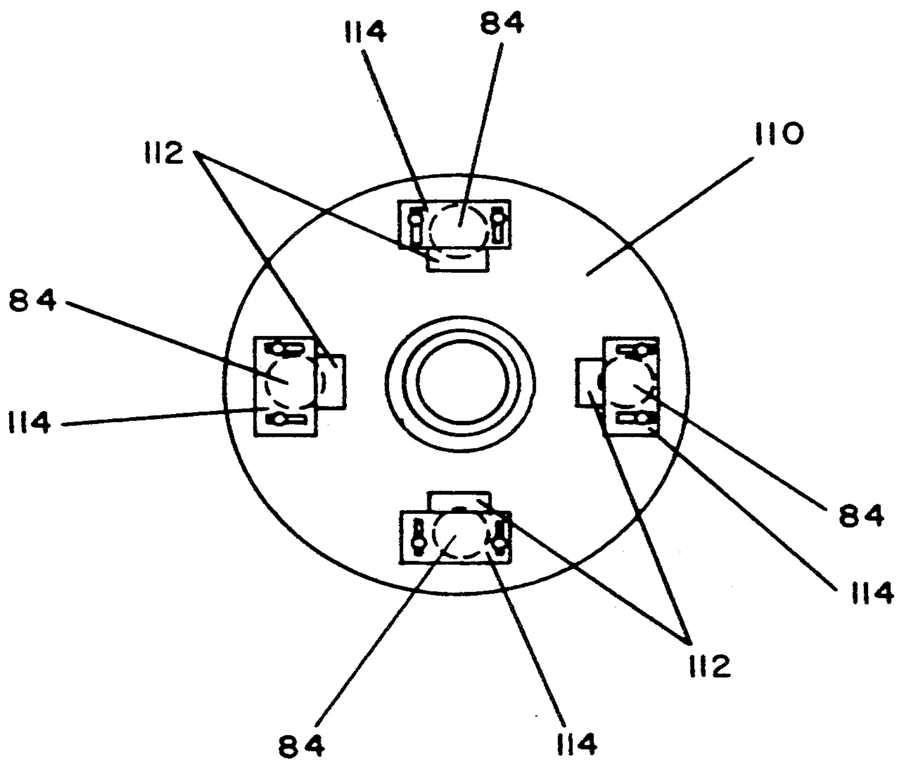


FIGURE 6

THREE STAGE CENTRIFUGE AND METHOD FOR SEPARATING WATER AND SOLIDS FROM PETROLEUM PRODUCTS

FIELD OF THE INVENTION

This invention relates to centrifuge apparatus and more particularly to a novel three stage centrifuge especially adapted to a method for separating water and solid particles from petroleum products.

BACKGROUND OF THE INVENTION

In the production and use of petroleum products such as crude oil, some oil may become contaminated with solid and liquid contaminants such as sediments and water. In general, excessive levels of any contaminants in a petroleum product yield a final product that is non-usable. Moreover, the contaminated petroleum product may be difficult to dispose of in an environmentally safe manner.

Sediment and water are the primary unwanted byproducts generated in the production of crude oil. All petroleum products contain some sediments and water with different ratios of oil, water and solids in various states of emulsification. In all cases, excessive levels of sediment and water yield a product that is unsellable, non-usable and non-disposable.

In order to utilize this otherwise dormant oil/water emulsion, the level of sediments and water must be reduced to acceptable levels. Conventional prior art processes require some form of chemical treatment to break the emulsion, followed by gravity separation. These processes are generally so expensive that the petroleum product released from the emulsion is often worth less than the cost of treating the emulsion.

The present invention is directed to a novel centrifuge apparatus and method especially adapted for mechanically separating contaminants such as sediment and water from petroleum products. It has particular application in oil field production operations where large volumes of contaminated crude oil can be treated to produce a marketable petroleum product. The apparatus and method of the invention also has application in the refinement and disposal of various oil/water emulsions such as waste oil from manufacturing or transportation operations, heavy grade coring oils, various blends of slop oil and water flood oil skim.

The apparatus of the invention includes a three-stage decanting centrifuge that is especially adapted to separating water and solid contaminants from oil. In the past, three stage centrifuges have been utilized to process different oil based emulsions. In the production of olive oil for example, three stage centrifuges are utilized to separate oil, water, and solid components of the processed olives. Such decanting centrifuges are well known in the art.

In general, however, these types of prior art three stage centrifuges are not suitable for processing heavy emulsions such as those occurring in crude oil production. Additionally, these prior art centrifuges are not suited to the environmental conditions (i.e. temperature climate) that may be encountered in oil field operations, nor the wide range of physical characteristics (i.e. viscosity, water content, solids levels, solids type) of different emulsions to be processed. For these reasons such contaminated oil has been mostly processed by chemical treatment and settling of the contaminants.

Moreover, there is a need for a method of separating contaminants from petroleum products so that these contaminants can be disposed of in an environmentally safe manner. Waste oil from oil spills, manufacturing operations, service stations, and oil refineries for instance, are very difficult to dispose of in an environmentally safe manner.

The present invention is directed to a three stage centrifuge adapted to overcome the limitations of prior art centrifuges and to provide a method suitable for removing contaminants from petroleum products so that the petroleum product may be used and the contaminants may be safely disposed.

SUMMARY OF THE INVENTION

In accordance with the present invention a three stage centrifuge apparatus and a novel method for separating water and solids from petroleum products is provided.

The three stage centrifuge includes a horizontally mounted rotatable bowl that spins the emulsion to separate the fluid oil and water into separate pools within the bowl and to throw the solid particles outward by gravity. A conveyor auger then contacts the solid particles and discharges these contaminants from the rotatable bowl as water wet solids. A water discharge means includes an adjustable weir located at one end of the rotatable bowl at a position within the rotatable bowl to draw the separated water into a water discharge conduit. An oil discharge means includes adjustable oil discharge tubes that are also located at a position within the rotatable bowl to draw the separated oil out of the rotatable bowl into an oil discharge conduit. Oil baffles mounted within the rotatable bowl maintain an oil pool and prevent the disruption of the water and oil fluid levels by incoming emulsion. Sensing and control means control the operation of the conveyor auger in response to the amount of solids in the emulsion.

In general the method of the invention, for separating water and solids form a petroleum product includes the steps of: agitating an emulsion; heating the emulsion to a selected temperature; pumping the emulsion at a selected flow rate to a rotatable bowl; centrifuging the emulsion in the rotatable bowl to separate the water, oil and solid particles of the emulsion so that different discharge means within the rotatable bowl can draw the separated liquids (oils and water) into separate discharge conduits; and conveying the solids out of the rotatable bowl as oil free and water wet solids.

The apparatus and method of the invention are adapted to process a wide range of contaminated products including lights oil, heavy oils, and chemically contaminated oils.

Other objects, advantages and capabilities of the present invention will become more apparent as the description proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram showing a method of separating water, solids and oil from an emulsion in accordance with the invention;

FIGS. 2 and 2A are schematic views of the centrifuge of the invention showing the separation of an emulsion into oil, water, and solid components by centrifugal force;

FIG. 3 is a perspective view of an apparatus constructed in accordance with the invention for carrying out the method of the invention;

FIG. 4 is a schematic diagram of the centrifuge of the invention showing relative movement of its components and movement of oil, water, and solids through the centrifuge;

FIG. 5 is a cross section taken through a centrifuge constructed in accordance with the invention; and

FIG. 6 is an end view of FIG. 5 showing construction and location of water weirs for the centrifuge.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As the term to an intimate used herein emulsion refers mixture of two incompletely miscible liquids such as oil and water in which one of the liquids is in the form of fine droplets dispersed in the other. In an illustrative embodiment, the emulsion is a petroleum product such as crude oil contaminated with sediment and water. Alternately, other emulsions such as used motor oils, emulsions of sulfur acid and oil, and spilled oils are also subject to process by the method and apparatus of the invention. In general, the process removes the water and solid contaminants from the petroleum product so that the product may be used and the contaminants disposed.

Referring now to FIG. 1 a method of processing a contaminated petroleum product or emulsion in accordance with the invention is shown. As a first step an emulsion such as crude oil having solid particles, water, and oil in an emulsified mixture is collected in a receptacle such as a feed tank 10. Prior to processing the emulsion the product may be analyzed to determine its content. As an example, a sample may be analyzed to ascertain the percentages of solids, water, and oil in the emulsion. The temperature of the product as well as its chemical composition may also be determined. This information may then be utilized to select the process parameters for processing the emulsion in accordance with the method of the invention.

In an illustrative embodiment of the invention the feed tank 10 is a sealed vessel. Alternately this receptacle need not be a sealed tank 10 but may be an open pit or pool that may be emptied of or continuously replenished with the emulsion to be processed.

With most contaminated petroleum products it may be necessary to stir or otherwise agitate the emulsion to provide a homogeneous mixture. This may be done by mechanical stirring or by bubbling compressed air through the emulsion. It may also be desirable to remove large solid objects such as rocks, rags, and vegetation from the petroleum product.

Agitation may be necessary for example to mix oil and water in the emulsion to provide a constant oil-water ratio to feed into the centrifuge 14. Also, an emulsion may contain solids entrained in the oil and mixing will evenly disperse these solids through the emulsion.

From the feed tank 10 the emulsion is pumped through suitable conduits by a feed pump 12 into a centrifuge 14 constructed in accordance with the invention. The feed pump 12 may be selected to maintain a desired flow rate for the emulsion.

Additionally, the feed pump 12 may be selected to pump the emulsion with a minimum of turbulence. The contaminated product may contain relatively large solid particles that are more efficiently removed from the emulsion if they remain unbroken. Breaking up a solid particle increases the total surface area of solids within the emulsion and promotes adherence of these smaller solids to the oil within the emulsion. It is therefore desirable to maintain relatively large solid particle sizes.

One suitable feed pump 12 for moving the emulsion from the feed tank 10 to the centrifuge 14 is a progressing cavity pump. These type of pumps may be utilized in low pressure applications for moving fluids in a laminar flow with a minimum of trauma to the fluid.

Suitable control means may be operably coupled to the feed pump 12 to achieve a selected output from the feed pump 12. Feed rates to the centrifuge 14 may vary depending on the type of emulsion being processed and on the rated capacity of the centrifuge 14. In an illustrative embodiment of the invention feed rates may be varied from about 15 gallons per minute (GPM) to a maximum of about 65 gallons per minute (GPM).

In addition to minimizing emulsification of the solid particles within the oil, a progressing cavity feed pump 12 may be controlled to maintain a smooth even flow of emulsion to the centrifuge 14. This is necessary to keep the centrifuge 14 running steady as surges or erratic flow tend to upset oil and water pools formed within the centrifuge 14. As an example, the feed pump 12 may be driven by an electric motor and controller 13 (FIG. 4). The speed of the electric motor may be controlled with a suitable motor controller so that the pump rate can be accurately controlled. This control can be used to fine tune the process and maintain steady operation of the centrifuge 14.

Prior to entry into the centrifuge 14, it may be necessary to heat the emulsion with an in-line heater 16. In general, an emulsion must be heated to increase the viscosity of the fluid so that it moves more easily through the centrifuge 14. Heating may also be required to change the characteristics of some emulsions in order to render the emulsion more susceptible to treatment. Parafin solvents may be used for example, in some oil field operations and it may be necessary to heat an emulsion containing parafin in order to maintain the parafin in liquid form.

In an illustrative embodiment of the invention the heater 16 is a continuous flow heater having electric submersible elements. A representative temperature range of the emulsion may be from about 125° F. to about 200° F. In general electric heaters are safer in this operation than gas heaters due to the possibility of flammable gases being present.

Some emulsion may not require heating if the emulsion is already at a suitable processing temperature. It may be detrimental to heat other types of emulsion such as for example crude oil or acid contaminated with sulfur. Moreover, heating should not be performed to a temperature that burns the light ends of the oil because this may form gases within the centrifuge 14.

In general more heat is required for oils having a large percentage of solids and for heavy oils. Less heat is required for light oils as well as oils having fine solids and sulfuric solids.

After heating, the emulsion is moved by the feed pump 12 into the centrifuge 14. As shown schematically in FIG. 2 and 2A the centrifuge 14 includes a horizontally mounted rotatable bowl 18 that spins about its longitudinal axis at relatively high rpm's (example approximately 1780 rpm). This rotation subjects the solid particles 20 within the emulsion to high g-forces (example 700–1000 g's) and moves these solid particles 20 radially outward towards the inside wall of the rotatable bowl 18 where they are conveyed away by a conveyor auger 22 (FIG. 4).

Additionally, as shown schematically in FIG. 2 and FIG. 2A, rotation of the rotatable bowl **18** creates separate pools of water **24** and oil **26** at different pool depths within the rotatable bowl **18**. The oil pool **26** is retained between baffle plates **76, 77**. These separate fluid levels of water **24** and oil **26** occur because water and oil do not mix and the fluids of different specific gravities are separated by centrifugal forces exerted by the rotatable bowl **18**. The point of separation between the oil and water is clearly delineated and in effect seals the two fluids from mixing.

As will hereinafter be more fully explained, separate discharge means, water discharge means **27** and oil discharge means **29** within the rotatable bowl **18**, remove the water and oil from the centrifuge **14** at different pool depths within the centrifuge **14**. Moreover, as previously stated, the conveyor auger **22** (FIG. **4**) conveys the solids out of the centrifuge **14**. A sensing and control means **33** regulates the speed of the conveyor auger **22** and the output of solids in response to the amount of solids in the emulsion.

With reference to FIG. **1**, discharge of the solids from the centrifuge **14** is represented by arrow **28**, discharge of oil is represented by arrow **30** and discharge of water represented by arrow **32**.

The liquid oil and water discharged from the centrifuge **14** may be gathered in suitable receivers (oil receiver **34**, water receiver **36**). The oil may then be pumped through suitable conduits by an oil pump **38** to a storage vessel **56, 58** (FIG. **3**). The water may be pumped away by a water pump **40**. Additionally, as shown schematically in FIG. **1**, some water may be pumped through conduits by a makeup pump **46** back into the centrifuge **14**. This make-up water may be required in the processing of some emulsions in order to facilitate separation of the solids and oil within the emulsion.

Referring now to FIG. **3**, the apparatus of the invention is shown in an illustrative embodiment. As shown the apparatus includes the centrifuge **14**, feed pump **12**, and heater **16**, all mounted on a movable trailer bed **48**. The trailer bed **48** may be transported by a truck in order to move and perform the method of the invention at different job sites. The centrifuge is mounted on a frame **49** or a stand located on the trailer bed **48**.

An operator enclosure **50** is mounted at an elevated end of the trailer bed **48**. The operator enclosure **50** contains various control means which enable an operator to control different parameters of the process (i.e. feed rate, temperature, discharge, continuity). The operator enclosure **50** provides an operator protection from the elements and may include one or more viewing windows **52**.

An emulsion to be processed such as crude oil contaminated with sediment and water is contained in an oil storage tank **42**. As previously explained, the emulsion may be agitated or stirred within the storage tank **42** as required. The feed pump **12** receives the emulsion though suitable conduits (not shown) from the storage tank **42** and moves the emulsion through the heaters **16** (as required) and into the centrifuge **14**. A solids discharge chute **54** receives the processed water wet solids from the centrifuge **14**. Storage tanks **56, 58** receive through suitable conduits (not shown) the processed oil from the centrifuge **14**.

Referring now to FIG. **4** a schematic of the centrifuge **14** is shown. The centrifuge **14** includes the rotatable bowl **18** and the conveyor auger **22**. Emulsion is pumped by the feed pump **12** through the center of the conveyor auger **22** and into the rotatable bowl **18**. Rotation of the rotatable bowl **18** separates the emulsion into the oil, water and solids. The solids are pushed as indicated by arrow **116** by the conveyor auger **22** to a solids discharge port **68**. The oil and water separated by centrifugal forces along a line of separation **82** are discharged at a fluid discharge end **78** of the rotatable bowl **18**. Oil is discharged from oil discharge tubes **80** located at a pool depth to contact only oil. Water is discharged from water weirs **84** located at a pool depth to contact only water.

In an illustrative embodiment of the invention the rotatable bowl **18** rotates about a longitudinal axis **60** in a clock wise direction as indicated by arrow **62**. Suitable drive means such as an electric drive motor (not shown) may be drivably coupled to the rotatable bowl **18** to power the rotation. As an example the rotatable bowl **18** may be rotated at about 1780 rpm.

The rotatable bowl **18** is hollow and generally cylindrical in shape but is formed with a tapered beach **64** of reduced cross section at one end. As will hereinafter be more fully explained, the tapered beach **64** provides an annulus of reduced cross section which during operation of the centrifuge fills partially with water.

The beach **64** of the rotatable bowl **18** may be lined with a smooth non-porous material such as ceramic tiles. This smooth surface provides reduced friction for solids that are pushed by the conveyor auger **22** through the beach **64** and out the solids discharge port **68**. Also, caked solids formed after a period of "shut down" are more easily separated from the beach **64** formed with a smooth surface.

The centrifuge **14** also includes the conveyor auger **22** that is concentrically mounted within the rotatable bowl **18** and is also journaled for rotation. In an illustrative embodiment of the invention, this direction of rotation of the conveyor auger **22** is opposite to the direction of rotation of the rotatable bowl **18** and is counterclockwise as indicated by arrow **66**. Alternately, both the rotatable bowl **18** and the conveyor auger **22** may rotate in the same direction.

The conveyor auger **22** may be driven by a suitable drive means such as a hydraulic drive motor **31** (FIG. **3**). The rotational speed of the hydraulic drive motor **31** may be closely controlled by suitable sensing and control means **33** (FIG. **1**) responsive to the amount of solids being conveyed to the discharge port **68**. A sensing and control means **33** may be utilized for instance that senses a hydraulic drive pressure on the hydraulic drive motor **31**. This pressure may then be related to the torque on the conveyor auger **22** exerted by the solids being conveyed. With the sensing and control means **33** an increase in pressure and in the torque caused by an increased amount of solid particles within the rotatable bowl **18** can be sensed and the conveyor auger **22** speed may be increased to handle the increased load. Jams and slugs of solid material can thus be cleared in this way to insure a constant flow of solids through the rotatable bowl **18** and discharge of solid material through the discharge port **68**.

The conveyor auger **22** is generally cylindrical in shape and is hollow in the middle. The conveyor auger **22** includes an inlet port **70** for the contaminated emulsion and a plurality of emulsion inlets **72** that discharge the emulsion into the rotatable bowl **18**. In an illustrative embodiment of the invention the emulsion is discharged into the rotatable bowl **18** with a flow direction

towards the fluids discharge end **78** of the rotatable bowl. Thus is termed a co-current inlet flow. Alternately, the centrifuge may be configured with a counter current inlet flow.

The conveyor auger **22** is formed with helically wound flights **74** on its outer periphery. These helical flights **74** move the solids that are pushed by centrifugal force against the inside of the rotatable bowl **18** through the rotatable bowl **18** and to the solids discharge port **68**.

As previously stated, in an illustrative embodiment of the invention the conveyor auger **22** turns in an opposite direction (CCW) than the rotatable bowl **18** (CW). Alternately the conveyor auger **22** may be configured however, to turn in the same direction as the rotatable bowl **18**, as long as it has flights **74** shaped to move solids material to the discharge port **68**.

As an example, the conveyor auger **22** may turn at from one to twelve revolutions per minute with respect to the rotatable bowl **18**. If the rotatable bowl **18** is turning for example at 1780 rpm the conveyor auger **22** must turn at this rate plus one to twelve rpm's more. This rate is termed herein as the conveyor augur ratio and in general is a number between one and twelve.

Two oil baffle plates **76, 77** are mounted on the conveyor auger **22** to maintain a pool of oil therebetween. A first oil baffle plate **76** is located adjacent to the emulsion inlets **72** to the rotatable bowl **18**. A second oil baffle plate **77** is located adjacent the fluids discharge end **78** of the rotatable bowl **18**. During operation of the centrifuge **14** the baffle plates **76, 77** function to maintain a pool of oil within the rotatable bowl **18** between the baffle plates **76, 77** so that the oil may be discharged through oil discharge tube **80** mounted to the rotatable bowl **18**.

Referring now to FIG. **5** the centrifuge **14** is shown in more detail in an actual cross section. As previously stated the centrifuge **14** includes the rotatable bowl **18** and the conveyor auger **22**. Additionally the entire assembly is enclosed by a stationary enclosure **86**.

The stationary enclosure **86** includes a solids discharge pan **88** that receives solids discharged from the solids discharge port **68**. The stationary enclosure **86** also includes an oil discharge section **90** for receiving oil thrown out of the oil discharge tubes **80**. The oil discharge section **90** of the stationary enclosure **86** terminates in a threaded coupling **92** that may be coupled to suitable conduits for pumping the processed oil into the storage tanks **56, 58** (FIG. **3**).

The stationary enclosure **86** also includes a water discharge section **94** for receiving water discharged from the water weirs **84**. The water discharge section **94** terminates in a threaded coupling **96**. This coupling **96** may be coupled to suitable conduits for pumping the water away or back into the centrifuge **14** to aid in processing some emulsions. An air space **79** is formed between the water discharge section **94** and oil discharge section **90**.

The rotatable bowl **18** is journaled for rotation on heavy bearings **98** which will be mounted on pillow blocks (not shown) on a stationary framework. A drive sheave **100** is drivably coupled to an electric drive motor for turning the rotatable bowl **18**. A thrust bearing **126** is mounted on an opposite end from the drive sheave **100**.

The hollow cylindrical conveyor auger **22** is mounted on a stationary hollow trunion **118** and is journaled on sleeve bearings **102, 104** for rotation within the rotatable bowl **18**. Suitable seal elements **120, 122** seal the conveyor auger **22** from the rotatable bowl **18** and stationary enclosure **86**. Other seal elements **124** seal the rotatable bowl **18** at the fluid's discharge end **78**. The conveyor auger **22** is coupled to a splined shaft **106** that drivably couples to a hydraulic drive.

The oil baffle plates **76, 77** are attached to the conveyor auger **22**. The oil baffle plates **76, 77** are flat and generally circular in shape and are welded directly to the conveyor auger **22**. These baffle plates **76, 77** are sized to confine the oil pool formed in the rotatable bowl **18** to retain oil between the emulsion inlets **72** and the oil discharge tubes **80**. This permits the oil discharge tubes **80** to draw only oil.

Water is also formed as a continuous pool **24** (see FIG. 2A) and extends into the beach area **64**. In addition to being located adjacent to the oil pool **26**, the water pool **24** is located on an opposite side from the oil pool **26** at the front baffle plate **76**. Additionally, at the fluids discharge end **78** of the rotatable bowl **18**, the water pool **24** extends on the opposite side of baffle **77** from the oil pool **26**. Additional baffle plates **108** may be welded over each of the four emulsion inlets **72** that are formed on the conveyor auger **22**. These baffle plates **108** function to keep emulsion directed from the emulsion inlets **22** into the rotatable bowl **18** from disrupting the separate fluid pools (oil **26** and water **24** [FIG. 2A]) formed within the rotatable bowl **18**. It is critical throughout the construction and operation of the centrifuge **14** to provide for a smooth laminar flow of fluids through the centrifuge **14**.

The flights **74** of the conveyor auger **22** are welded directly to the generally cylindrical exterior of the conveyor auger **22**. The flights **74** are machined to an outside diameter that is just slightly less than the inside diameter of the rotatable bowl **18**. This arrangement permits fine or water caked solid particles to be pushed by the edge of the flights **74** to the solids discharge port **68**. As is apparent the flights **74** tend to push the solids mostly through the water pool **24** located along the inner wall of the rotatable bowl **18** and the water pool **24** formed in the beach area **64**. This movement of solids through water helps to scrub the solid particles free of oil so that the discharged particles are water wet and not encapsulated with oil. As an example, in order to meet some environmental regulatory specifications, these discharge solids must contain less than about 10,000 PPM of oil.

The oil discharge tubes **80** are mounted directly to the rotatable bowl **18**. In an illustrative embodiment there are four oil discharge tubes **80**, a set of two front tubes and a set of two back tubes. The front tubes are located farther into the interior of the rotatable bowl than the two back tubes which are located adjacent to the oil baffle plate **77**. This axial offset is indicated by distance "x" in FIG. **5**. These two sets of axially offset oil discharge tubes **80** each function to draw oil from the oil pool **26** but at different axial points along the longitudinal axis **60** of the rotatable bowl **18**. (As shown in FIG. 2A the oil pool **26** is formed in a continuous pool **26** located between the baffle plate **76, 77**). The front oil discharge tubes tend to draw oil out in a pool area in front of the oil baffle plate **77** whereas the back tubes tend to draw oil out at a pool area adjacent to the baffle plate **77**. Because these two sets of oil discharge tubes **80** are located at different axial points in the oil pool **26** (FIG. 2A), the efficiency of oil discharge is

improved and the discharge of water with the oil is decreased or eliminated.

Each oil discharge tube **80** is mounted on a threaded stud. This permits the tubes **80** to be located at an optimum depth within the oil pool **26** for drawing only oil from the pool.

The water weirs **84** for discharging water from the centrifuge are located on a end plate **110** attached to the end of the rotatable bowl **18**. As shown in FIG. **6** the end plate **110** has four generally rectangular shaped openings **112** formed therethrough. Slotted plates **114** partially cover the openings **112**. The location of these slotted plates **114** may be adjusted as required at a pool depth for withdrawing only water from the rotatable bowl **18**.

EXAMPLE 1

An Emulsion of Oil/Water/Light Solids

Before processing any emulsion, a sample of the emulsion is first subjected to a laboratory centrifuge or "grind out" to ascertain its characteristics, including solids content, oil percentage, water percentage and chemical composition if necessary. This helps to determine the process parameters to be used in processing the emulsion. Additionally the "grind out" rpm's and diameter of the lab centrifuge can be utilized to determine "g" forces in the processing of the emulsion. In general emulsions having a solids content of less than 30% are considered light solids.

Weir Setting

A light solids fluid requires a relatively deep water pool to insure constant and smooth flow of water through the centrifuge **14**. This is done by moving the water weirs plates **114** towards the center of the centrifuge.

Oil Tubes

With light oil, the oil tubes **80** must be set radially inward to keep a deep pool of oil between the baffles plates **76**, **77**. This gives more retention time in the centrifuge **14** and produces a better or optimal separation of oil, solids and water. This is necessary with light oil because in general light oils have relatively fine solids entrained in the oil. Accordingly, more retention time within the centrifuge is required to separate these fine particles from the emulsion. The initial setting of the oil tubes **80** may have to be changed after start up. This setting will depend on the percentage of oil in the emulsion and the feed rate to the centrifuge **14**.

Conveyor Auger

In all oils the conveyor ratio should be run as low a possible to keep agitation in the centrifuge **14** to a minimum. A good starting ratio is 2–3. This may have to be increased if solids are not conveying out of centrifuge **14** fast enough. This may cause the centrifuge **14** to load up with solids and carry over solids into the fluid discharge.

Feeding Fluids

With oil and water it is easy to ascertain an optimal pool setting. As soon as oil and water pools form at the predetermined depths and fluid discharge occurs there should be an instant oil water split. It will take some period of operation (ex. 15 minutes) for the centrifuge to level out at this rate. The feed rate into the centrifuge can then be set to achieve maximum volume and an optimum separation of fluid and solids. Every oil has its own characteristic and can only be processed relative to its physical characteristics and solids content. Feed rates vary from, as an example, 15 GPM to a maximum of 60–65 GPM.

Agitation

Agitation for oils is necessary to mix oil and water and to achieve a constant oil water ratio feed to the centrifuge **14**. Lighter oils may not need as much agitation as sulfur containing or heavier oils because finer solids tend to stay tied up in the fluid. This is called an inner phase. These solids are emulsified or oil coated and are entrained in the fluids. Caution should be taken to not use to much agitation or emulsification can become tighter. This requires more retention time to make a clean split of the liquids and solids. If there is little or no water in the feed tank **42** it should only be mixed long enough to stir the solids off of the bottom of tank and keep the fluids moving smoothly through inlet hoses.

Temperature

In general light oils may be processed at the same temperature as used in the production of the oils. This temperature is usually a maximum that the oil can take before the light end of the oil is cooked or burned. If cooking occurs, gases will be produced in the centrifuge. This will upset the pool depths in the centrifuge **14** and may cause unacceptable oil and water discharges. If this occurs, the heaters **16** should be shut down until the fluid cools to its operating temperature. If any changes need to be made, the centrifuge must be given time to smooth out. Some lighter oil may take more heat to help keep optimal splits. More heat may be required with light oils because light oils have a tendency to be burnt with chemicals. More heat will help break bond of the oil with the chemically burnt oil.

Injection and Chemicals

On some light oils there are usually finer solids which in turn have tighter emulations. This is when injection and chemicals are needed. In most cases the best additive to use is water. If the centrifuge is not making clean splits on solids and oil, the make-up water can be injected into the centrifuge to help wash the oil off the solids. This is also helpful when the centrifuge **14** will not smooth out or maintain steady oil water splits due to the lack of water in the emulsion. Make-up water may also be necessary when pumping near the bottom of the feed tank **42** if there is very little water left in tank. Some oils have chemical additives and may have been over treated or burned. In some cases a chemical such as a solids dispersant can be utilized. The right chemical and injection rate need to be determined for proper use.

Discharge Fluids

Most discharged water should be clear when viewed through a sample jar. In some cases though the water may carry a brownish tint. This can come from the color of some chemicals carrying through with the water. The centrifuge should be adjusted to make the water as clean as possible and free of solids. Oil discharge should be as clean as possible and should be checked by "grind out" to meet specifications. Specifications may vary depending on GPM through centri-

fuge and percentage of water and solids in the emulsion. One goal is to achieve a pipeline grade oil.

Thus, the invention provides a method and apparatus for processing contaminated liquids such as an emulsion, to separate oil, water, and solids from the emulsion. While the invention has been described with reference to preferred embodiments thereof, as will be apparent to those skilled in the art, certain changes and modification can be made without departing from the scope of the invention as defined by the following claims.

What is claimed is:

1. A three stage centrifuge for separating oil, water and solids from a petroleum product emulsion comprising:

a generally cylindrical shaped rotatable bowl having a tapered beach section of a reduced cross section with the bowl rotatable to separate the emulsion into separate oil and water pools and to throw solids radially outward by centrifugal force;

drive means for rotating the rotatable bowl;

conveyor means within the rotatable bowl for conveying solids through the rotatable bowl to a solids discharge port adjacent to the tapered beach;

means for pumping emulsion to an emulsion inlet and into the rotatable bowl with a minimum of turbulence and with substantially no breaking of solid particles;

drive means for driving the conveyor means;

a pair of baffle plates mounted within the rotatable bowl for forming an oil pool therebetween;

oil discharge means including an adjustable oil discharge tube mounted between the baffle plates to draw oil from the oil pool and out of the rotatable bowl;

water discharge means mounted within the rotatable bowl to contact the water pool and draw water out of the rotatable bowl;

baffle means associated with the emulsion inlet for baffling flow of emulsion into the centrifuge to prevent disrupting of the oil and water pools; and

sensing and control means for controlling the conveyor means responsive to a torque exerted by the solids in the emulsion.

2. The centrifuge as claimed in claim **1** and wherein: the oil discharge means comprises adjustable oil discharge tubes mounted to the rotatable bowl and axially offset from one another along a longitudinal axis of the rotatable bowl.

3. The centrifuge as claimed in claim **1** and further comprising:

means for agitating the emulsion prior to inlet into the rotatable bowl.

4. The centrifuge as claimed in claim **1** and wherein: the pump means is a progressing cavity pump.

5. The centrifuge as claimed in claim **1** and wherein: the tapered beach of the rotatable bowl is lined with a ceramic material.

6. The centrifuge as claimed in claim **1** and wherein: the drive means for rotating the conveyor means is a hydraulic drive; and

the sensing and control means senses pressure on the hydraulic drive and increases or decreases a speed of the drive means responsive to torque exerted by solids on the conveyor means.

7. The centrifuge as claimed in claim **1** and wherein: the conveyor means is an auger having helically wound flights for moving solids through the rotatable bowl to the solids discharge port.

8. The centrifuge as claimed in claim **1** and wherein: the rotatable bowl is surrounded with a stationary enclosure having a solids discharge section for receiving solids form the discharge port, an oil discharge section for receiving oil from the oil discharge means and a water discharge section for receiving water from the water discharge means.

9. A three stage centrifuge for separating oil, water and solids from a petroleum product emulsion comprising:

a rotatable bowl for receiving and rotating the emulsion in order to exert centrifugal force on the emulsion to separate the emulsion into water and oil pools and to move the solids radially outward, with the rotatable bowl having a tapered beach section at one end with a solids discharge port;

drive means for rotating the rotatable bowl;

a generally cylindrical shaped conveyor auger rotatably mounted within the rotatable bowl and having an emulsion inlet and helically wound flights for contacting solids and for moving the solids through a water pool formed in the rotatable bowl to the discharge port;

hydraulic drive means for rotating the conveyor auger;

pressure sensing and control means for sensing and varying pressure to the hydraulic drive means with varying torque on the conveyor auger exerted by solids in the emulsion in order to control a speed of the conveyor auger;

a feed pump for pumping emulsion to the emulsion inlet and into the rotatable bowl with a minimum of turbulence and substantially without breaking solid particles in the emulsion;

a first baffle plate mounted to the conveyor auger adjacent to the emulsion inlet and a second baffle plate mounted to the conveyor auger adjacent to a fluid's discharge end of the rotatable bowl;

a first oil discharge tube mounted to the rotatable bowl between the first and second baffle plates and a second oil discharge tube mounted to the rotatable bowl between the first and second baffle plates with the first and second oil discharge tubes axially offset and adjustable to contact an oil pool formed within the rotatable bowl for discharging the oil;

an adjustable water weir mounted to an end of the rotatable bowl for contacting a water pool formed within the rotatable bowl and for discharging the water from the rotatable bowl; and

a third baffle plate associated with the emulsion inlet for preventing disruption of the oil and water pools by incoming emulsion.

10. The three stage centrifuge as claimed in claim **9** and further comprising:

heating means for heating the emulsion prior to pumping into the rotatable bowl.

11. The three stage centrifuge as claimed in claim **10** and wherein:

the feed pump is a progressing cavity pump.

12. The three stage centrifuge as claimed in claim **11** and wherein:

the beach is lined with a ceramic material.

13. The three stage centrifuge as claimed in claim **10** and wherein:

the conveyor auger turns relative to the rotatable bowl at a rate of from one to twelve revolutions per minute.

14. The three stage centrifuge a claimed in claim 13 and wherein:

the direction of rotation of the rotatable bowl and the conveyor auger are opposite to one another.

15. The three stage centrifuge as claimed in claim 14 and further comprising:

means for agitating the emulsion prior to entry into the rotatable bowl.

16. The three stage centrifuge as claimed in claim 15 and wherein:

there are two sets of axially offset oil discharge tubes.

17. A method of processing a petroleum fluid to remove water, and solids comprising:

agitating the fluid to provide a homogeneous mixture;

heating the fluid to a selected temperature;

pumping the fluid with a minimum of turbulence and substantially without breaking of solid particles in the fluid at a selected feed rate to a generally cylindrical rotatable bowl having a beach section of reduced cross section;

rotating the fluid within the rotatable bowl in order to separate the fluid into separate oil and water pools and to throw solids in the fluid outward by centrifugal force within the rotatable bowl;

conveying the solids within the rotatable bowl through a water pool formed in the beach area of the rotatable bowl to a solids discharge port;

dischargin oil from the rotatable bowl through an oil discharge means having an oil discharge tube within the rotatable bowl placed into the oil pool and located between oil baffle plates within the rotatable bowl;

discharging water from the rotatable bowl through a water discharge means placed into the water pool;

sensing and controlling a rate of conveying of the solids to the solids discharge port in response to the amount of solids; and

baffling incoming fluid into the rotatable bowl to prevent disruption of the oil and water pools.

18. The method as recited in claim 17 and wherein:

pumping the fluid is by means of a progressing cavity pump.

19. The method as recited in claim 18 and further comprising:

injecting a chemical solids dispersant into the fluid.

* * * * *

US006860845B1

(12) **United States Patent**
Miller et al.

(10) **Patent No.: US 6,860,845 B1**
(45) **Date of Patent: Mar. 1, 2005**

(54) **SYSTEM AND PROCESS FOR SEPARATING MULTI PHASE MIXTURES USING THREE PHASE CENTRIFUGE AND FUZZY LOGIC**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 171 days.

(21) Appl. No.: **10/051,324**

(22) Filed: **Jan. 22, 2002**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/357,339, filed on Jul. 14, 1999, now abandoned.

(51) **Int. Cl.**[7] **B04B 1/20**; B04B 13/00

(52) **U.S. Cl.** **494/1**; 494/13; 494/37; 494/53; 494/901; 700/273; 706/900

(58) **Field of Search** 706/50, 1, 900; 494/1, 5, 7–10, 13, 37, 38, 42, 50–54, 56, 57, 901; 700/273; 210/96.1, 143, 380.1, 380.3, 739, 781, 787

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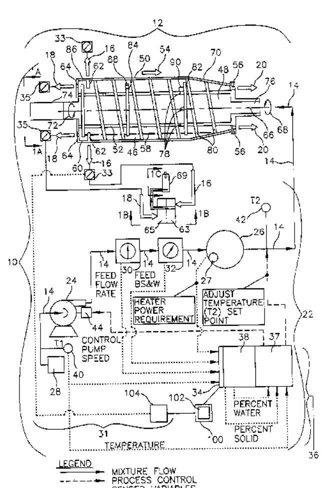
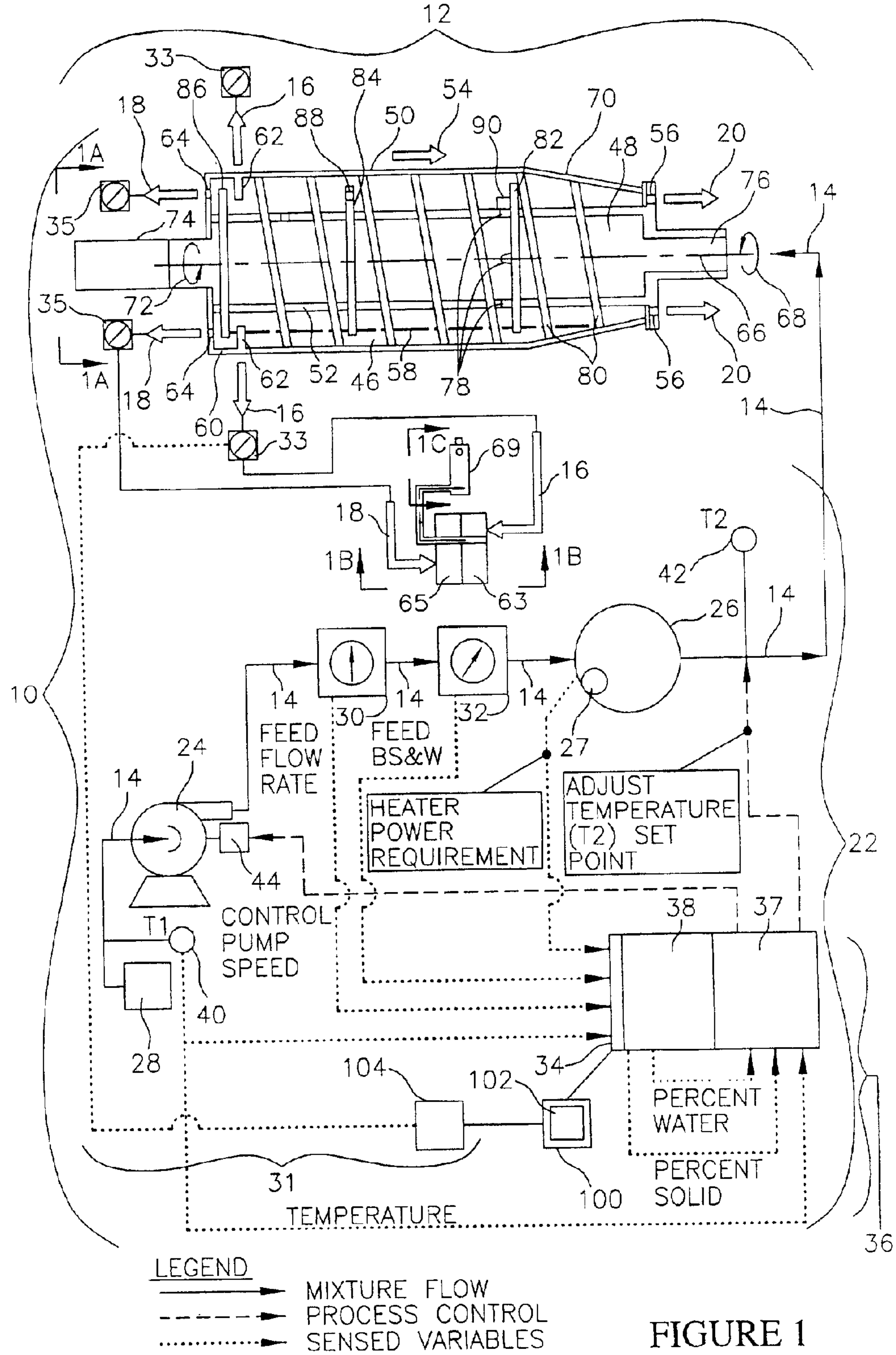
Primary Examiner—Charles E. Cooley
(74) *Attorney, Agent, or Firm*—Stephen A. Gratton

(57) **ABSTRACT**

A system for separating a multi phase mixture into a first liquid phase component, a second liquid phase component and a solid phase component includes a three phase centrifuge and a control system for the centrifuge. The control system includes a fuzzy soft sensor programmed with fuzzy logic rules and a feed forward controller in signal communication with the fuzzy soft sensor. The feed forward controller is configured to adjust a feed rate and a feed temperature of the mixture based on the rules, the cold feed temperature, the percent change of water in the mixture, and the percent change of solids in the mixture. The system also includes a feedback controller configured to adjust the feed rate and the feed temperature of the mixture based on the rules, and the basic water and solid (BS&W) content of the first liquid phase component.

29 Claims, 11 Drawing Sheets





FEED
FLOW
RATE
FEED
BS&W
HEATER
POWER
REQUIREMENT
ADJUST
TEMPERATURE
(T2) SET
POINT
CONTROL
PUMP
SPEED
PERCENT
WATER
PERCENT
SOLID
TEMPERATURE
LEGEND
MIXTURE FLOW
PROCESS CONTROL
SENSED VARIABLES

FIGURE 1

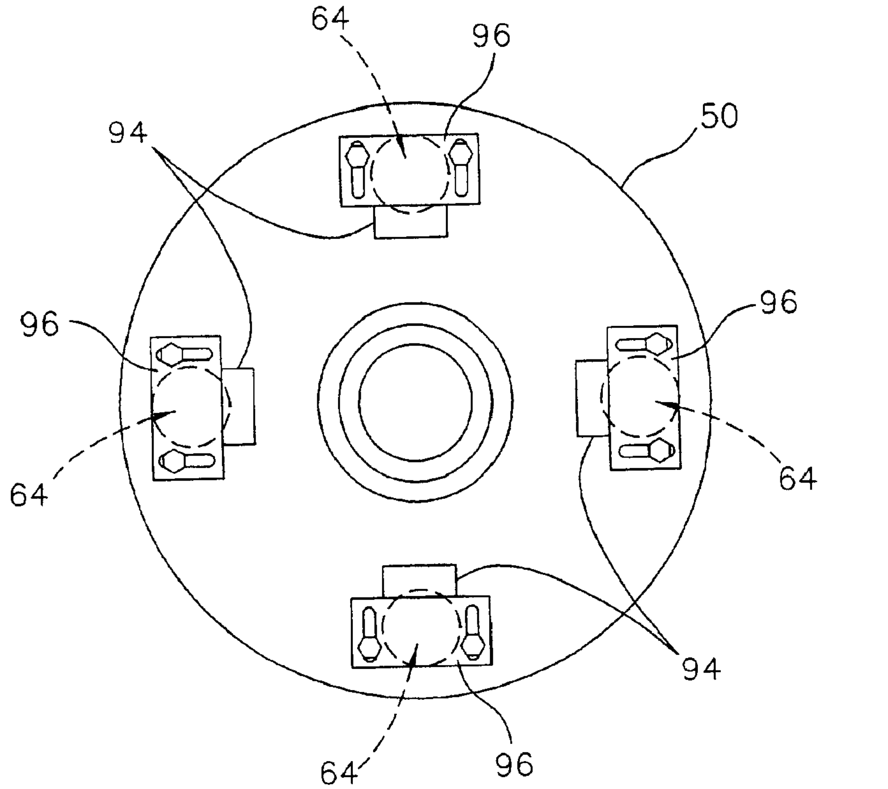


FIGURE 1A

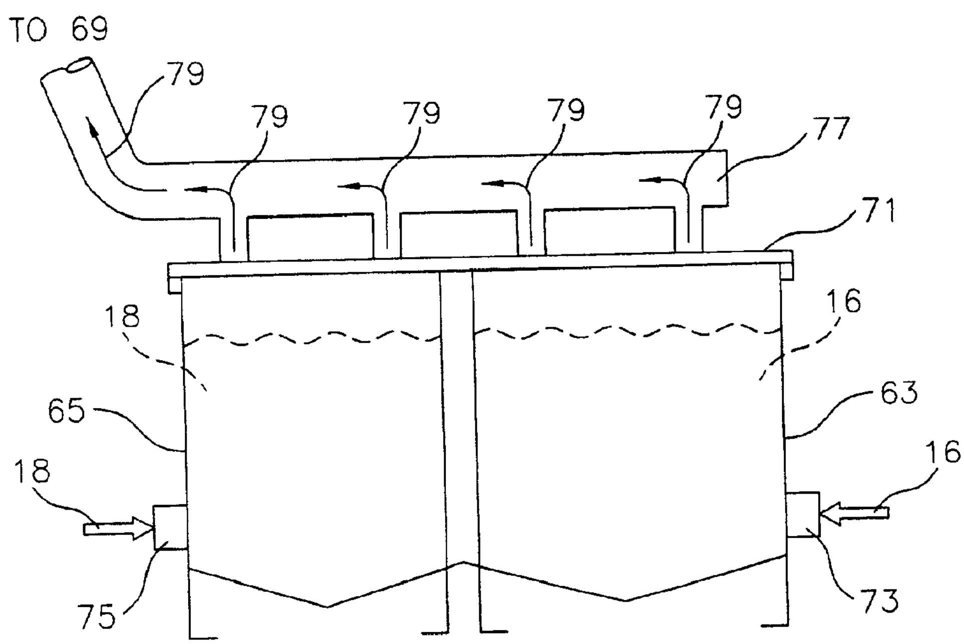


FIGURE 1B

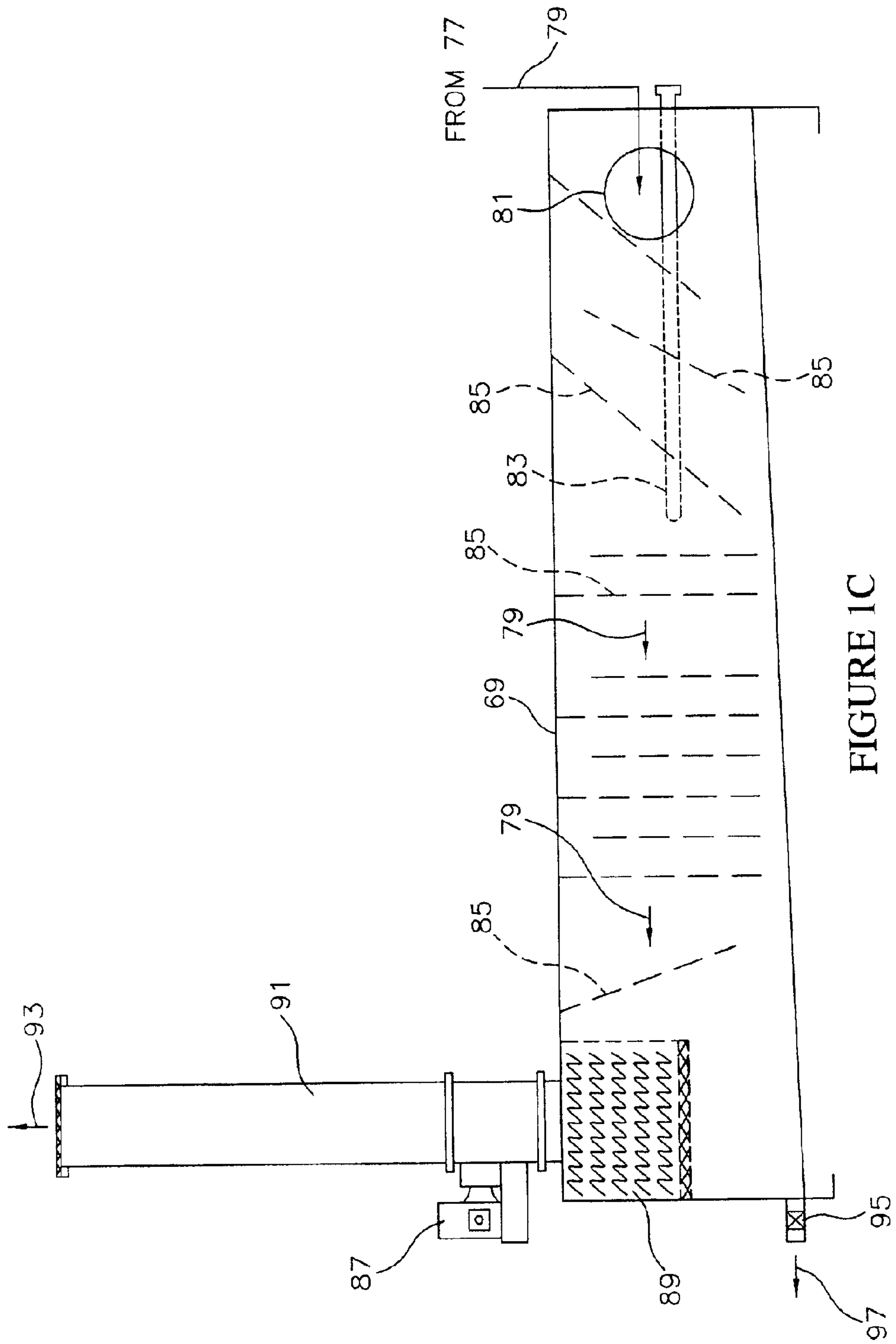


FIGURE 1C

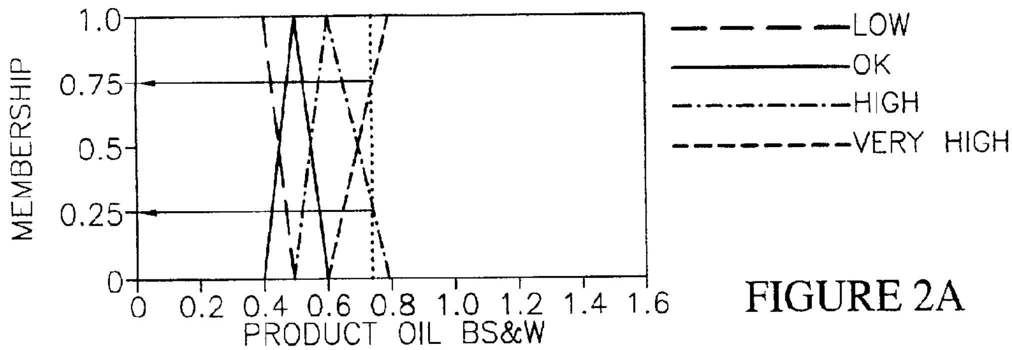


FIGURE 2A

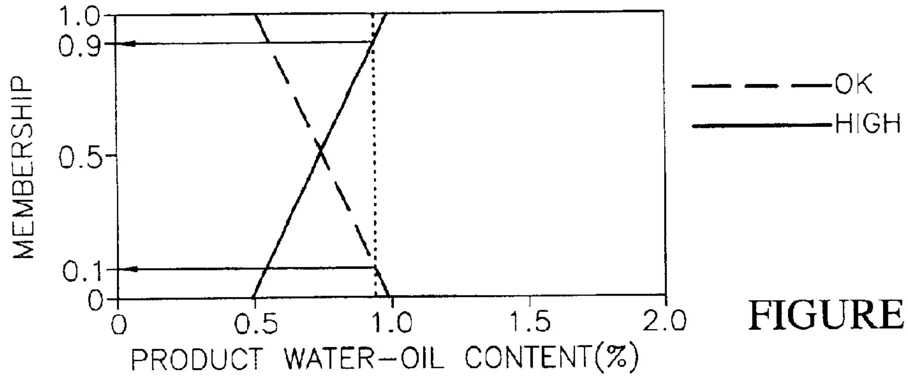


FIGURE 2B

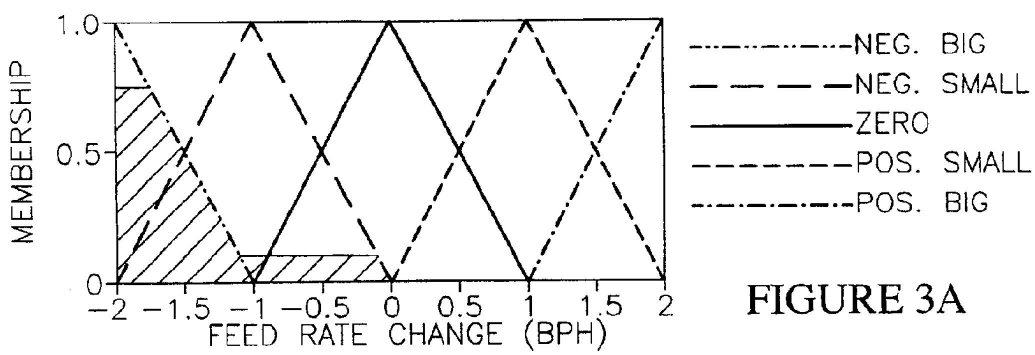


FIGURE 3A

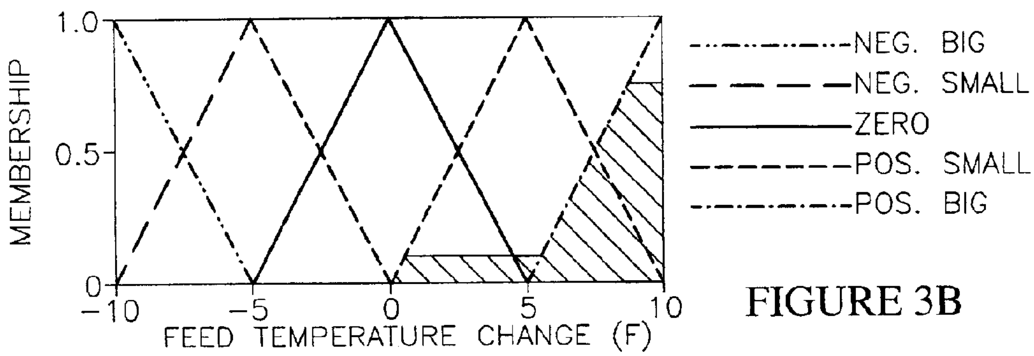


FIGURE 3B

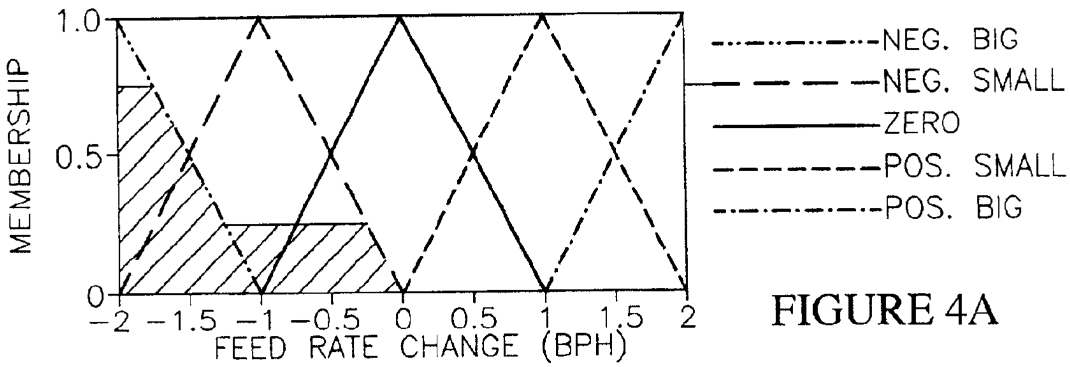


FIGURE 4A

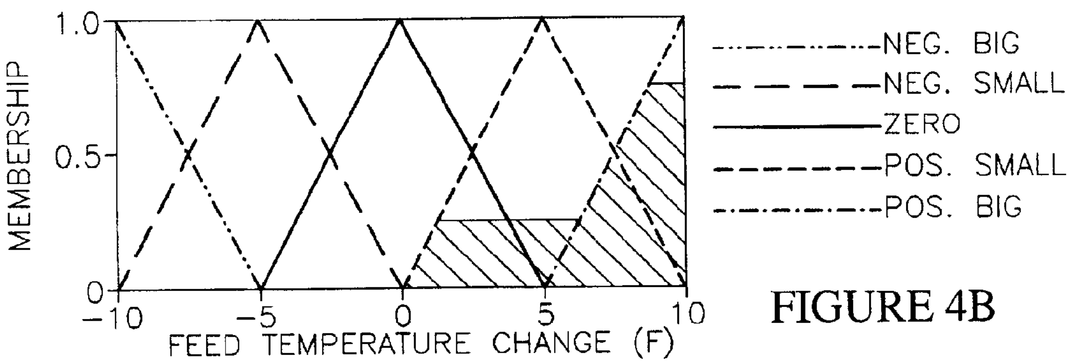


FIGURE 4B

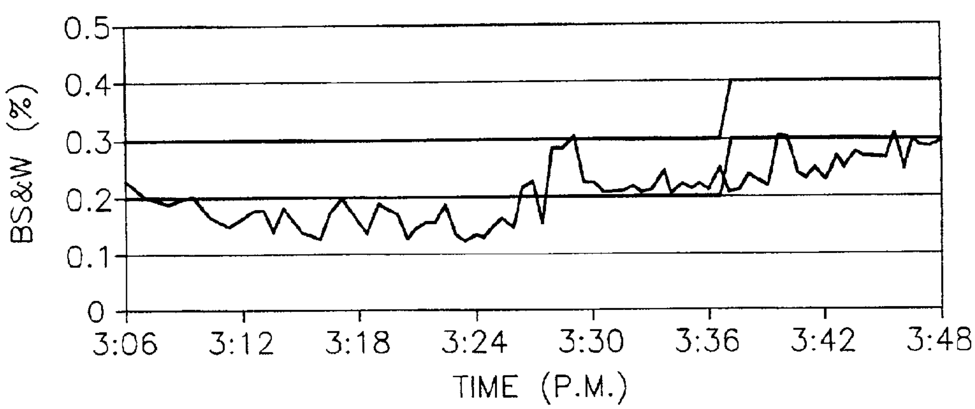


FIGURE 4C

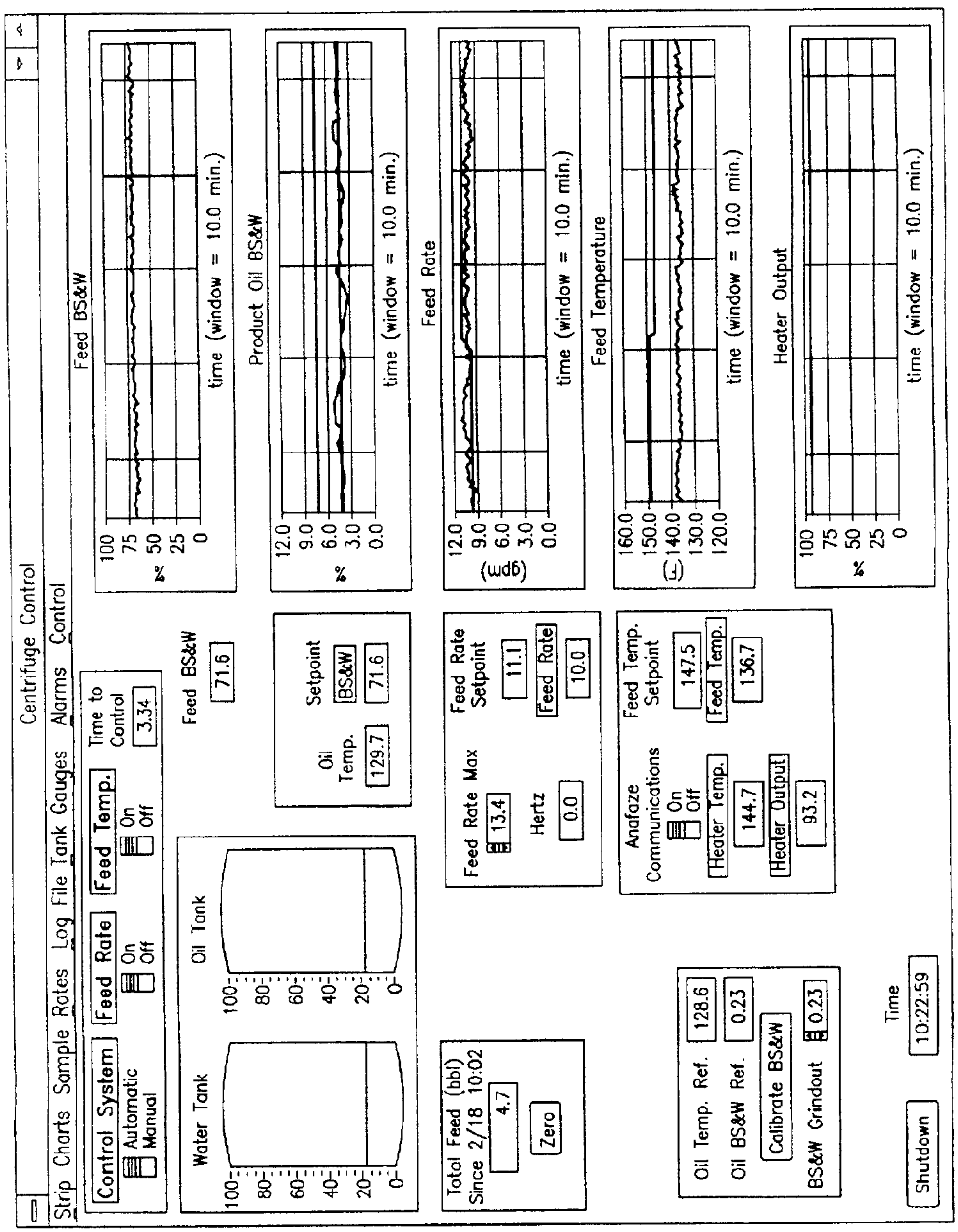

Centrifuge Control
Strip Charts Sample Rates Log File Tank Gauges Alarms Control
Control System
Automatic
Manual
Feed Rate
On
Off
Feed Temp.
On
Off
Time to Control
3.34
Feed BS&W
71.6
Water Tank
Oil Tank
Oil Temp.
129.7
Setpoint
BS&W
71.6
Feed Rate Max
13.4
Hertz
0.0
Feed Rate Setpoint
11.1
Feed Rate
10.0
Anafaze Communications
On
Off
Heater Temp.
144.7
Heater Output
93.2
Feed Temp. Setpoint
147.5
Feed Temp.
136.7
Total Feed (bbl) Since 2/18 10:02
4.7
Zero
Oil Temp. Ref.
128.6
Oil BS&W Ref.
0.23
Calibrate BS&W
BS&W Grindout
0.23
Time
10:22:59
Shutdown
Feed BS&W
Product Oil BS&W
Feed Rate
Feed Temperature
Heater Output
time (window = 10.0 min.)

FIGURE 5

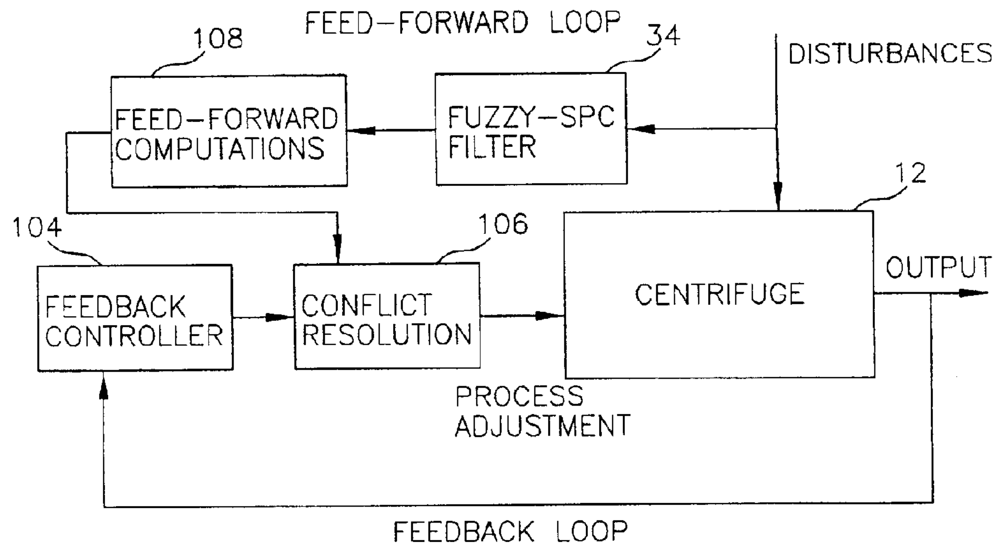


FIGURE 6A

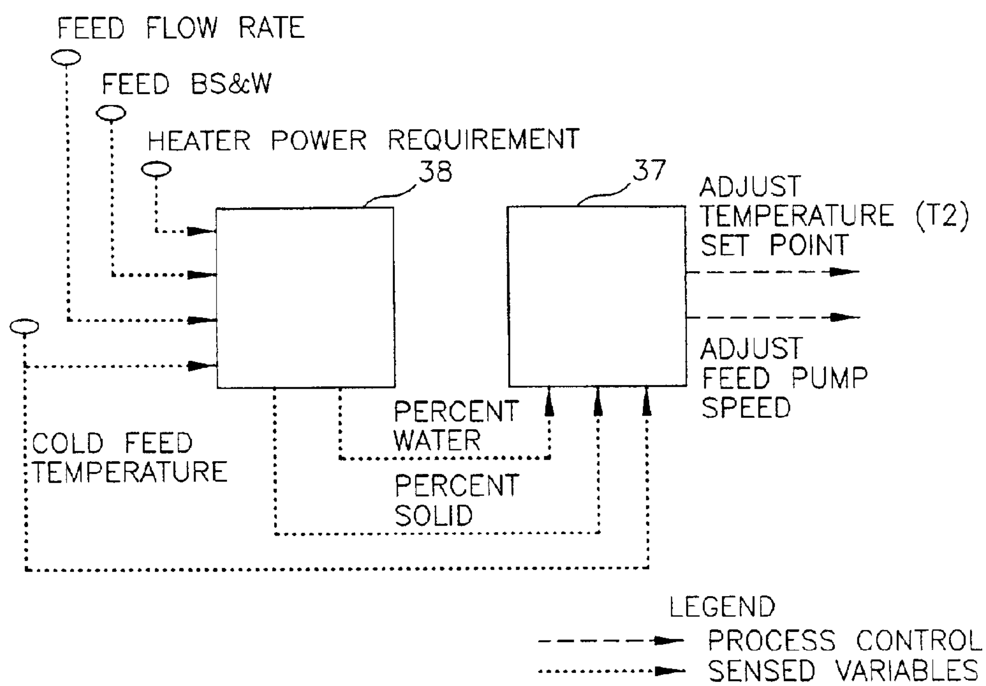


FIGURE 6B

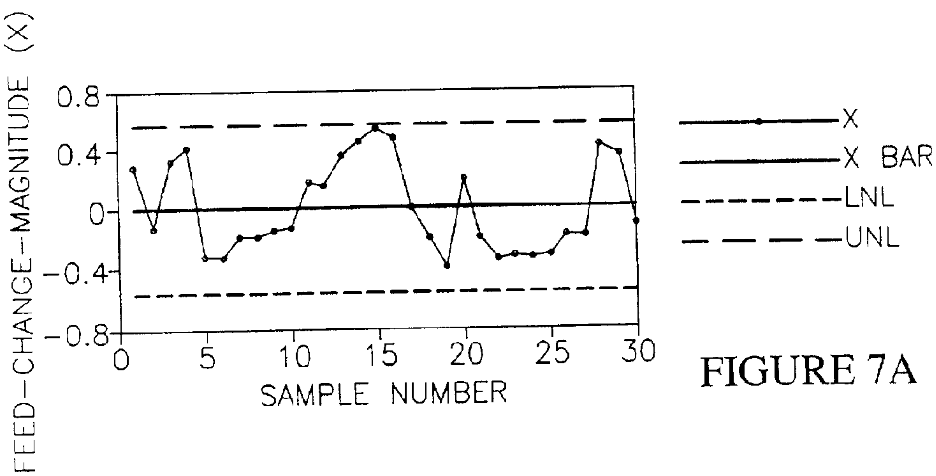


FIGURE 7A

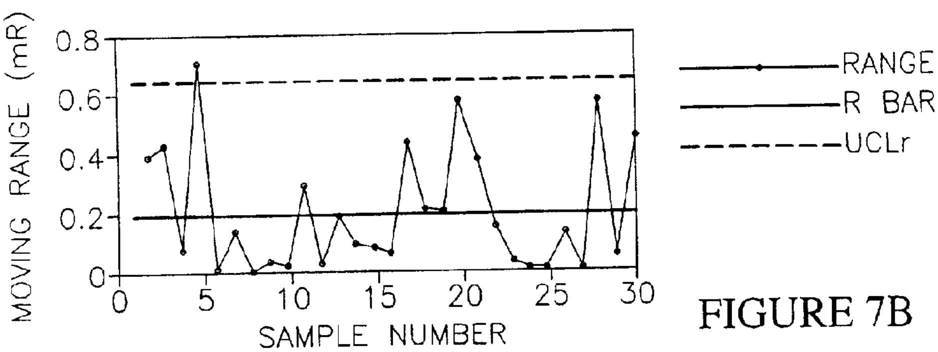


FIGURE 7B

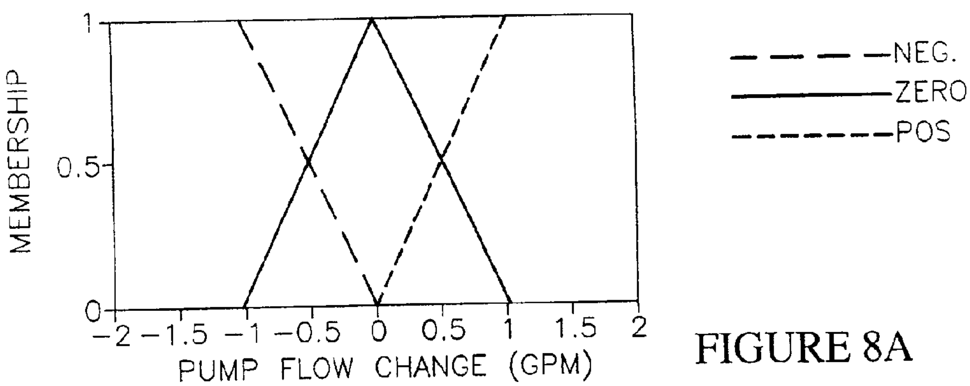


FIGURE 8A

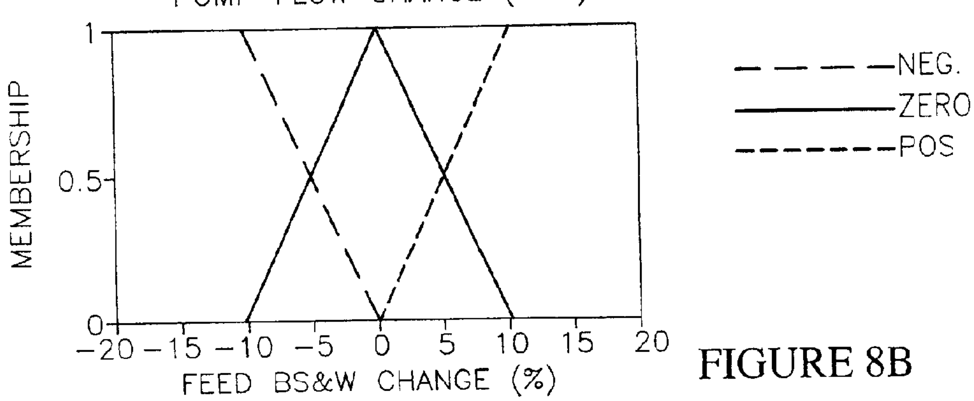


FIGURE 8B

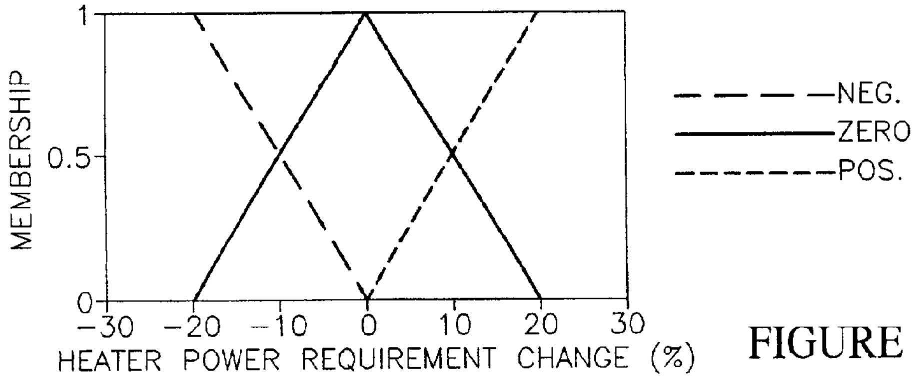


FIGURE 8C

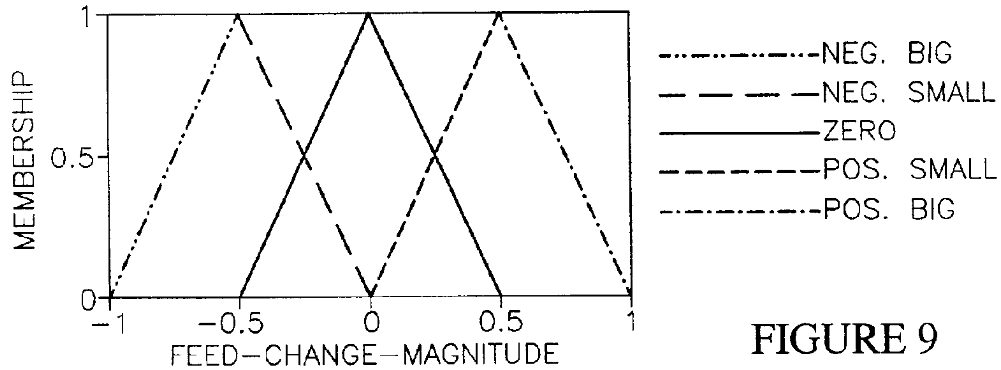


FIGURE 9

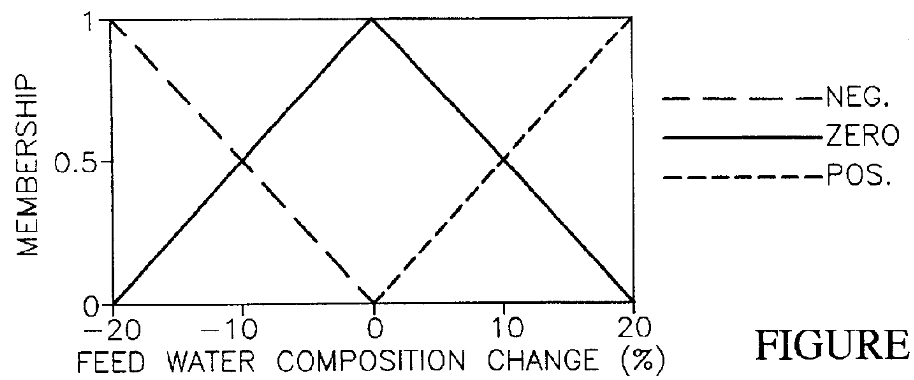


FIGURE 10A

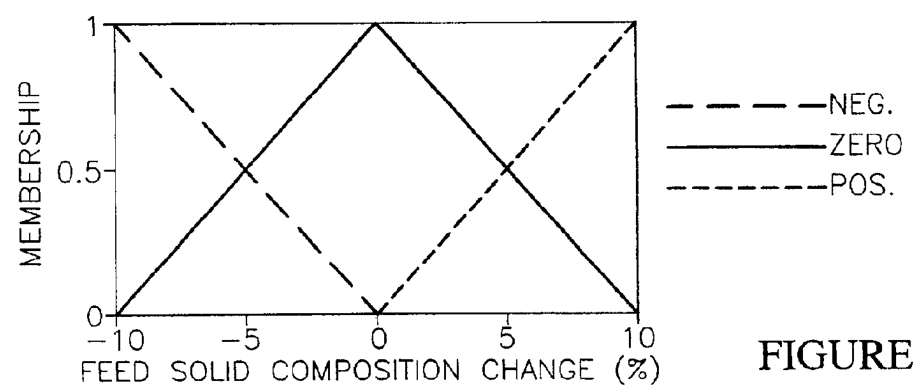


FIGURE 10B

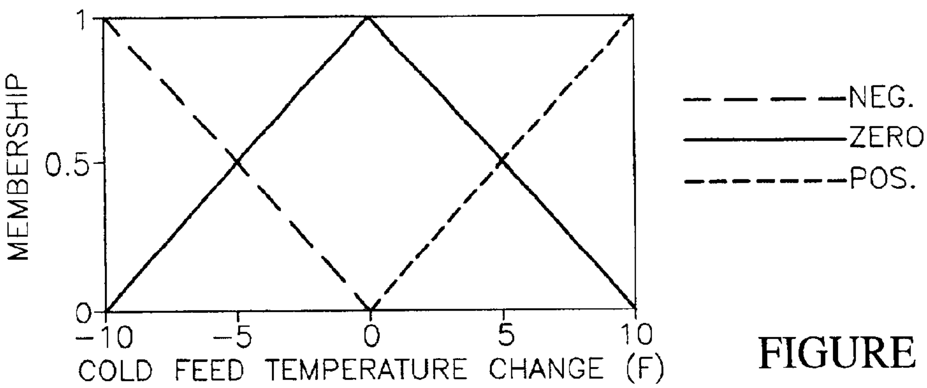


FIGURE 10C

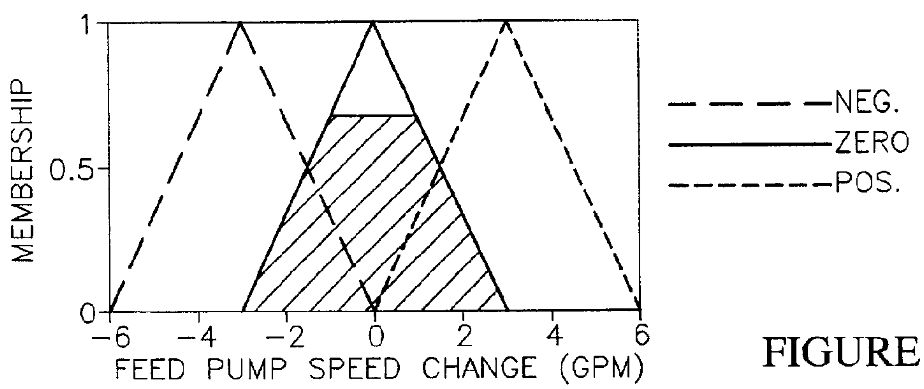


FIGURE 11A

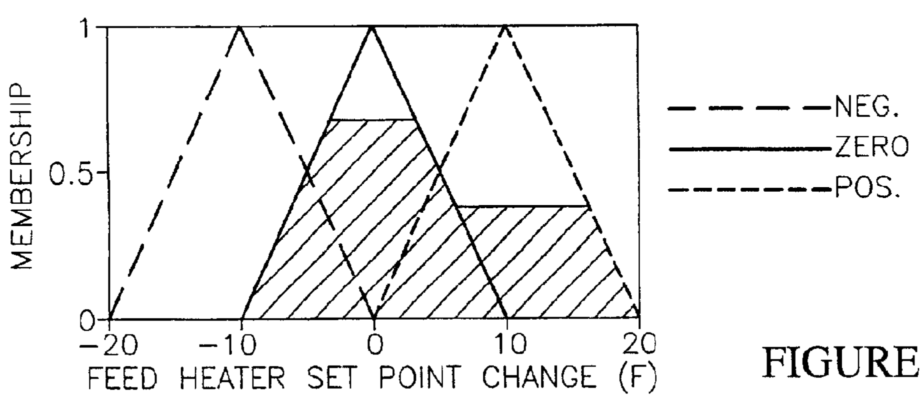


FIGURE 11B

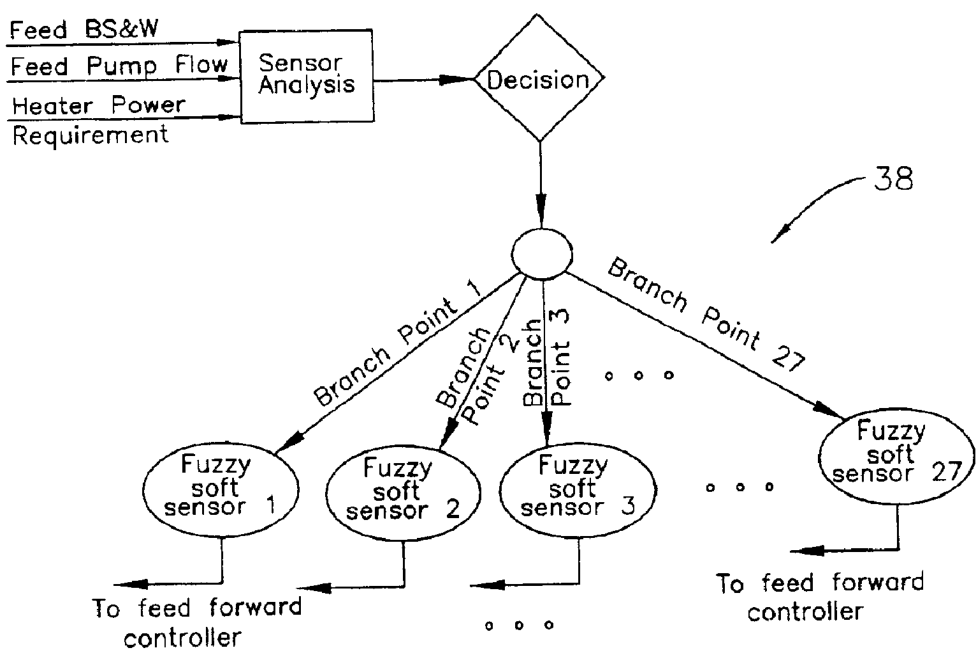

Feed BS&W
Feed Pump Flow
Heater Power
Requirement
Sensor Analysis
Decision
38
Branch Point 1
Branch Point 2
Branch Point 3
Branch Point 27
Fuzzy soft sensor 1
Fuzzy soft sensor 2
Fuzzy soft sensor 3
Fuzzy soft sensor 27
To feed forward controller
To feed forward controller

FIGURE 12

SYSTEM AND PROCESS FOR SEPARATING MULTI PHASE MIXTURES USING THREE PHASE CENTRIFUGE AND FUZZY LOGIC

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of Ser. No. 09/357,339, filed July 14, 1999, now abandoned.

FIELD OF THE INVENTION

This invention relates generally to chemical processing, and more particularly to a system and to a process for separating three phase mixtures, such as crude oil, into separate components.

BACKGROUND OF THE INVENTION

In the Chemical Processing Industries (CPI) process control is an important consideration. Issues associated with process control are often complex and non-linear and require human judgment and experience.

One example of a chemical process with control issues occurs during waste separation processes in the petroleum industry. For example, in the production of crude oil, contaminants in the solid phase and contaminants in the liquid phase may be present in a mixture containing the oil. Excessive levels of contaminants yield a final product that is non-usable. In addition, contaminated crude oil can be difficult to dispose of in an environmentally safe manner.

One separation system for oil mixtures includes a three stage centrifuge which mechanically separates the contaminants from the oil. U.S. Pat. No. 5,156,751 to Miller discloses this type of system. The control of such a system is difficult because there are several variables that affect the separation process and the purity of the final product. These variables are difficult to model and incorporate into a control system for the centrifuge.

For example, the oil mixture enters the centrifuge as a meta-stable emulsion containing two liquid phases (oil and water) and a solid phase (solids). The physical properties of the mixture required for modeling the control system, are variable and not well understood. In addition, the mechanics of the centrifuge introduce variables that are also difficult to characterize and quantify. The centrifuge includes a tapered bowl and an internal conveyor auger rotating at different rotational speeds. The solids and the oil separate from the water at different rates depending on the rotational speeds of the bowl and the auger. Further, the feed rate and the temperature of the oil mixture, the size of the solids, and the type of the oil, also affect the separation process. In addition, during the separation process the oil and the water can interact in an unpredictable manner. Even a simple model of this system does not represent it well enough to be used for control purposes.

In view of the multitude of variables, in the past a skilled operator with broad experience and intuitive knowledge is required to successfully operate the separation system. However, skilled operators are difficult to train, and expensive to pay. It would be advantageous to utilize the experience and intuitive knowledge of a skilled operator to formulate an automated control system for the separation system.

The present invention recognizes that fuzzy logic techniques can be utilized to construct an automated control system that simulates the experience and judgment of a skilled operator. Rather than modeling the system, the fuzzy logic models the skilled operator.

SUMMARY OF THE INVENTION

In accordance with the present invention, a system and a process for separating a multi phase mixture, such as an oil emulsion, into separate components are provided. The system includes a three phase centrifuge configured to separate the mixture into a first liquid phase component (oil), a second liquid phase component (water) and a solid phase component (solids).

The system also includes a control system configured to measure process variables and to control process parameters. The control system includes a fuzzy soft sensor programmed with a set of fuzzy logic rules, and a feed forward controller in signal communication with the fuzzy soft sensor. The fuzzy soft sensor and the feed forward controller are configured to adjust process parameters, such as a feed temperature and a feed rate of the mixture, based on the rules and the measured feed forward variables. The system also includes a feedback controller configured to adjust process parameters based on the rules and measured feed back variables, such as the water or oil content of the first and second liquid phase components.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram of a separation system including a fuzzy logic control system and centrifuge constructed in accordance with the invention;

FIG. **1A** is a schematic end view of the centrifuge taken along line **1A**—**1A** of FIG. **1**;

FIG. **1B** is a schematic side elevation view of catch tanks for the centrifuge taken along line **1B**—**1B** of FIG. **1**;

FIG. **1C** is a schematic side elevation view of a vapor recovery unit of the centrifuge taken along line **1C**—**1C** of FIG. **1**;

FIG. **2A** is a chart illustrating input membership functions for product oil BS&W, only the triangles represent the membership functions, the vertical dotted lines and the arrows are associated with Examples 1 and 2;

FIG. **2B** is a chart illustrating input membership functions for product water-oil content, only the triangles represent the membership functions, the vertical dotted lines and the arrows are associated with Example 1;

FIG. **3A** is a chart illustrating output membership functions for feed rate change, the cross hatched regions represent clipped membership functions associated with Example 1;

FIG. **3B** is a chart illustrating output membership functions for feed temperature change, the cross hatched regions represent clipped membership functions associated with Example 1;

FIG. **4A** is a chart illustrating the clipped output membership functions from Example 2 for the feed rate change in barrels per hour using the rules in Table 2;

FIG. **4B** is a chart illustrating the clipped output membership functions from Example 2 for the feed temperature change in ° F. using the rules in Table 2;

FIG. **4C** is a chart illustrating the product oil BS&W as a function of time from an actual run using the rules in Table 2;

FIG. **5** is a view of a control screen for the fuzzy logic control system;

FIG. **6A** is a flow diagram illustrating operation of a feed forward loon and feedback loop for the fuzzy feed forward control system;

FIG. **6B** is a flow diagram illustrating the operation of a fuzzy feed forward control system and fuzzy soft sensor of the fuzzy logic control system;

FIG. **7**A is a chart illustrating feed magnitude change for the a fuzzy SPC filter of the fuzzy logic control system;

FIG. **7**B is a chart illustrating moving chart range for the fuzzy SPC filter of the fuzzy logic control system;

FIG. **8**A is a chart illustrating input membership functions for the variable pump flow change (gpm) for the fuzzy SPC filter;

FIG. **8**B is a chart illustrating input membership functions for the feed BS&W change (%) for the fuzzy SPC filter;

FIG. **8**C is a chart illustrating input membership functions for the variable heater power requirement change for the fuzzy SPC filter;

FIG. **9** is a chart illustrating output membership functions for the variable feed change magnitude for the fuzzy SPC filter;

FIG. **10**A is a chart illustrating input membership functions for feed water composition change (%);

FIG. **10**B is a chart illustrating input membership functions for feed solid composition change;

FIG. **10**C is a chart illustrating input membership functions for cold feed temperature change (° F.);

FIG. **11**A is a chart illustrating output membership functions for feed pump speed change;

FIG. **11**B is a chart illustrating feed heater set point change (° F.); and

FIG. **12** is a flow diagram illustrating operation of a fuzzy soft sensor of the fuzzy logic control system;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As used herein, the term "fuzzy logic rule" means a rule that takes it's input from semantic variables that are not normally precisely defined (such as "high", "low", "large", "small") and provides output that can be quantified (e.g., 10 volts, etc.).

As used herein the term "BS&W" is an acronym for basic solids and water content.

The term "multi-phase" mixture means combinations of two or more substances in which each substance retains it own composition and properties. In the illustrative embodiment the multi-phase mixture comprises an oil emulsion containing a first liquid phase component in the form of oil, a second liquid phase component in the form of water, and a solid phase component in the form of sediment or other solid matter. With respect to the liquid phase components one of the components has a higher specific gravity than the other liquid phase component (e.g., water has a higher specific gravity than oil). Also with respect to the liquid phase components, one of the liquid phases can be termed the "continuous phase" in which case the other liquid phase is dispersed in the continuous phase as droplets. For example, if water is the continuous phase, oil droplets are dispersed throughout the water. If oil is the continuous phase, water droplets are dispersed throughout the oil.

Separation System

Referring to FIG. **1**, a separation system **10** constructed in accordance with the invention is illustrated. The separation system **10** is configured to perform a separation process in which a multi phase mixture **14** (oil emulsion) is separated into a first liquid phase component **16** (oil), a second liquid phase component **18** (water) and a solid phase component **20** (solids).

The separation system **10** includes a three phase centrifuge **12** configured to mechanically separate the multi phase mixture **14** into the separate components **16**, **18**, **20**. In addition, the separation system **10** includes a feed pump **24** configured to receive the multi phase mixture **14** (oil emulsion) from a receptacle **28**, such as a tank or a pond, and to inject the mixture **14** into the centrifuge **12**.

The feed pump **24** preferably comprises a progressive cavity pump configured to move fluids in a laminar flow, or in some cases turbulent flow, with a minimum of trauma. This prevents fracturing and emulsification of the multi phase mixture **14** (oil emulsion). The feed pump **24** also includes a variable drive mechanism **44**, such as a variable frequency electric motor, constructed to rotate with a selected revolutions per minute. The speed of the variable drive mechanism **44** is controlled in a manner to be hereinafter described to control the speed, and thus the feed rate, of the feed pump **24**. Representative feed rates for the multi phase mixture **14** (oil emulsion) can be from about 5 gallons per minute to about 65 gallons per minute (GPM).

The separation system **10** also includes a heater **26** configured to heat the multi phase mixture **14** (oil emulsion) prior to injection into the centrifuge **12**. The heater **26** can comprise a continuous flow electric heater having submersible heater elements configured to heat the multi phase mixture **14** (oil emulsion) responsive to the power applied to the elements. Suitable heater elements are manufactured by Ogden Manufacturing of Arlington Heights, Ill.

As will be further explained, the power applied to the heater elements, which is termed herein the "power requirements" of the heater **26**, are controlled to achieve a selected temperature set point (T2) for the multi phase mixture **14** (oil emulsion). A representative temperature range for the temperature set point (T2) can be from about 125° F. to 200° F.

The separation system **10** also includes a fuzzy logic control system **22** configured to control the feed pump **24** to achieve a desired feed flow rate, and the heater **26** to achieve a desired feed temperature set point. The fuzzy logic control system **22** includes a flow meter **30** configured to measure a feed flow rate of the multi phase mixture **14** (oil emulsion). The flow meter **30** can comprise a conventional electronic flow meter which provides data in an electronic or digital format representative of the feed flow rate of the multi phase mixture **14** (oil emulsion). One suitable flow meter is manufactured by Controlotron of Hauppauge, N.Y. and is designated a model no. 191N1S. As will be further explained, the flow meter **30** provides data for controlling the output of the feed pump **24** and the power requirements of the heater **26**.

The fuzzy logic control system **22** also includes a first BS&W meter **32** configured to measure the BS&W content of the multi phase mixture **14** (oil emulsion), and a second BS&W meter **33** configured to measure the BS&W content of the first liquid phase component **16** (oil) discharged from the centrifuge **12**. Suitable BS&W meters **32**, **33** are manufactured by Invalco of Hutchinson, Kans., with a model no. CX-454-200 being suitable for BS&W meter **32**, and a model no. CX-645-200 BGP being suitable for BS&W meter **33**. As will be further explained, the BS&W meters **32**, **33** provide data for controlling the output of the feed pump **24**, and the power requirements of the heater **26**.

Optionally the fuzzy logic control system **22** can also include a water quality meter **35** configured to measure the percentage of oil in the second liquid phase component **18** (water). As will be further explained, the water quality meter **35** can be used to provide data for controlling the output of the feed pump **24**, and the power requirements of the heater **26**.

The fuzzy logic control system **22** also includes a first temperature sensor **40** configured to measure a cold feed

temperature (T1) of the multi phase mixture **14** (oil emulsion) pumped by the feed pump **24** from the receptacle **28**. In addition, a second temperature sensor **42** is configured to measure a temperature set point (T2) of the multi phase mixture **14** (oil emulsion) prior to injection into the centrifuge **12**.

The fuzzy logic control system **22** also includes a fuzzy feed back control system **31** configured to detect the BS&W content of the first liquid phase component **16** (oil), and optionally, the oil content of the second liquid phase component **18** (water). As will be further described, this information is then used to ascertain membership in the input membership functions. Using these memberships and the fuzzy rules the feed flow rate is adjusted by changing the power input to the feed pump **24**. In addition, the feed temperature is adjusted by setting a new temperature set point (T2). In this regard, the heater **22** includes a hardware standard PID controller **27** configured to adjust the heater power in order to comply with the power required to reach and maintain the temperature set point (T2). With feedback control, this procedure is repeated until the measured product requirements are met or optimized. In the examples to follow the BS&W content of the first liquid phase component **16** (oil) is met or optimized.

The fuzzy logic control system **22** also includes a fuzzy feed forward control system **36** configured to detect changes in measured feed variables (cold feed temperature T1, feed BS&W content, feed flow rate) of the multi phase mixture **14** (oil emulsion). The feed forward control system **36** makes control adjustments before operational problems with the centrifuge **12** occur. In particular the feed forward control system **36** attempts to predict future behavior based upon current feed conditions. It then makes adjustments in advance in preparation for the coming changes, thus optimizing future output. As with the feed back control system **31**, the feed forward control system **36** changes the feed flow rate and the temperature set point (T2). Since these are the same variables that the feed back control system **31** changes, conflicts are resolved using a conflict resolution code to be hereinafter described.

Elements of both control systems **31**, **36** can be contained in a computer **100** programmed with software containing rules to be hereinafter described. Input data from both control systems **31**, **36** is quantified using the rules to make control adjustments.

Centrifuge

As shown in FIG. **1**, the centrifuge **12** includes a rotatable bowl **50** and a conveyor auger **52**. The rotatable bowl **50** is generally cylindrical in shape and has a hollow interior portion **46**. Similarly, the conveyor auger **52** has a hollow interior portion **48**. The three phase mixture **14** (oil emulsion) is pumped by the feed pump **24** through the interior portion **48** of the conveyor auger **52**, and into the interior portion **46** of the rotatable bowl **50**.

The rotatable bowl **50** is journaled on heavy duty bearings (not shown) and is rotated by a drive motor (not shown). The rotatable bowl **50** rotates about a longitudinal axis **66** thereof, in a clock wise direction as indicated by arrow **68**. A representative rotational speed of the rotatable bowl **50** is from 500 rpm to 3500 rpm. This rotation imparts centrifugal forces on the multi phase mixture **14** (oil emulsion) of about 700–1000 g's. The centrifugal forces separate the multi phase mixture **14** (oil emulsion) into the first liquid phase component **16** (oil), the second liquid phase component **18** (water) and the solid phase component **20** (solids).

During the separation process centrifugal forces in the rotatable bowl **50** move the solid phase component **20** (solids) towards the outer diameter of the rotatable bowl **50** where it is pushed as indicated by arrow **54** by the conveyor auger **52**. In addition, the conveyor auger **52** pushes the solid phase component **20** (solids) through one or more solids discharge ports **56** that are in flow communication with the interior portion **46** of the rotatable bowl **50** and with the atmosphere. At the solids discharge ports **56** the solid phase component **20** (solids) can be collected in a suitable receptacle (not shown) for disposal or other use.

Because the first liquid phase component **16** (oil) and the second liquid phase component **18** (water) have different specific gravities, separate pools of these components form within the interior portion **46** of the rotatable bowl **50**. In particular, the first liquid phase component **16** (oil) and the second liquid phase component **18** (water) are separated by the centrifugal forces along a line of separation **58**, and are discharged at a fluid discharge end **60** of the rotatable bowl **50**. The first liquid phase component **16** (oil) is discharged from elongated discharge tubes **62** located at a pool depth to contact only the first liquid phase component **16** (oil). The discharge tubes **62** are in fluid communication with a first catch tank **63** (oil) which collects the first liquid phase component **16** (oil).

The second liquid phase component **18** (water) is discharged from weirs **64** located at a pool depth to contact only the second liquid phase component **18** (water). As shown in FIG. **1**A, the weirs **64** are formed on an end plate **92** of the rotatable bowl **50**. Specifically, the end plate **92** includes four generally rectangular shaped openings **94**, and slotted plates **96** partially cover the openings **94**. The locations of the slotted plates **96** can be adjusted as required to a selected pool depth for withdrawing the second liquid phase component **18** (water). The weirs **64** are in fluid communication with a second catch tank **65** (water) which collects the second liquid phase component **18** (water). In addition, a vapor recovery unit **69** collects and recovers vapor from the first catch tank **63** (oil) and the second catch tank **65** (water). The structure and function of the vapor recovery unit **69** will be more fully described as the description proceeds.

The rotatable bowl **50** includes a tapered beach **70** of reduced cross section proximate to an inlet **76** of the conveyor auger **52**. The tapered beach **70** provides an annulus of reduced cross section which during operation of the centrifuge fills partially with the second liquid phase component **18** (water). The tapered beach **70** can be lined with a smooth non-porous material such as ceramic tiles. This smooth surface provides reduced friction for the solid phase component **20** (solids), which is pushed by the conveyor auger **52** through the beach **70** and out the solids discharge ports **56**.

The conveyor auger **52** is concentrically mounted within the rotatable bowl **50** and journaled for rotation about the longitudinal axis **66**. The direction of rotation of the conveyor auger **52** is opposite to the direction of the rotation of the rotatable bowl **50** which is counterclockwise as indicted by arrow **72**. The conveyor auger **52** may be driven by a suitable drive means **74** such as a hydraulic or electric motor.

The inlet port **76** for the conveyor auger **52** is configured to receive the three phase mixture **14** through suitable piping in flow communication with the feed pump **24**. In addition, the conveyor auger **52** includes a plurality of emulsion inlets **78** formed through an outside diameter thereof configured to discharge the three phase mixture **14** from its hollow interior portion **48** into the hollow interior portion **46** of the rotatable bowl **50**. In the illustrative embodiment of the invention, the three phase mixture **14** is discharged into the rotatable bowl **50** with a flow direction towards the fluids discharge end **60**

of the rotatable bowl **50**. This is termed a co-current inlet flow. Alternately, the centrifuge **12** may be configured with a counter current inlet flow.

The conveyor auger **52** also includes helically wound flights **80** on its outer periphery. The helical flights **80** move the solid phase component **20** (solids) against the inside of the rotatable bowl **50** and through the solids discharge ports **56**. The conveyor auger **52** can rotate at from one to twelve revolutions per minute with respect to the rotatable bowl **50**. For example, if the rotatable bowl **50** is rotating at 1780 rpm, the conveyor auger **52** can rotate at this rate plus one to twelve rpm's more. This rate is termed herein as the "conveyor auger ratio" and in general is a number between one and twelve.

The centrifuge **12** also includes three oil baffle plates **82, 84, 86** attached to the conveyor auger **52** and configured to maintain the pools of the first liquid phase component **16** (oil) therebetween. A first baffle plate **82** is located generally perpendicular to the longitudinal axis **66** of the rotatable bowl **50** proximate to the inlet **66** to the conveyor auger **52**. A second baffle plate **84** is located generally perpendicular to the longitudinal axis **66** of the rotatable bowl **50** proximate to a center portion thereof. A third baffle plate **86** is located generally perpendicular to the longitudinal axis **66** of the rotatable bowl **50** proximate to the fluids discharge end **60**.

During operation of the centrifuge **12** the baffle plates **82, 84, 86** function to confine the pool of the first liquid phase component **16** (oil) so that the first liquid phase component **16** can be discharged through the discharge tube **62**. In addition, the center baffle plate **84** can include at least one opening **88** to permit flow of the first liquid phase component **16** (oil) therethrough. Further, additional baffle plates **90** can be located generally parallel to the longitudinal axis **66** of the rotatable bowl **50** proximate to the inlets **78** through the conveyor auger **52**. The baffle plates **90** prevent the three phase mixture **14** entering the interior portion **46** of the rotatable bowl **50** from disrupting the pools of the first liquid phase component **16** (oil).

Vapor Recovery Unit

Referring to FIGS. **1B** and **1C**, the catch tanks **63, 65** and vapor recovery unit **69** are illustrated. As shown in FIG. **1B**, the catch tanks **63, 65** comprise sealed vessels having a removable cover **71**. The first catch tank **63** (oil) includes an inlet **73** configured to receive the first liquid phase component **16** (oil). The second catch tank **65** (water) also includes an inlet **75** configured to receive the second liquid phase component **18** (water). In addition, the catch tanks **63, 65** include a manifold **77** in flow communication with the interiors of the catch tanks **63, 65** and with the vapor recovery unit **69**. The manifold **77** is configured to receive vapor **79** from the catch tanks **63, 65** and to transfer the vapor **79** to the vapor recovery unit **69**. The manifold **77** can be constructed of metal tubing, and is configured to receive the vapor which collects in the catch tanks **63, 65** in the space between the cover **71** and the liquid levels.

As shown in FIG. **1C**, the vapor recovery unit **69** comprises a sealed vessel having an inlet **81** configured to receive the vapor **79** from the manifold **77** (FIG. **1B**), and an exhaust stack **91** configured to exhaust hot air **93** to the atmosphere. The vapor recovery unit **69** also includes a fan **87** configured to move the vapor **79** from the manifold **77** (FIG. **1B**) and through the vapor recovery unit **69**. One suitable fan **87** is a belt driven tube axial fan manufactured by Dayton of Niles, Ill. and designated a model no. 4C659A.

The vapor recovery unit **69** also includes a drain valve **95** configured to discharge the liquefied vapor or condensate **97** into a collection vessel (not shown) such as an oil drum. The vapor recovery unit **69** also includes a plurality of baffles **83, 85** configured to collect and condense the vapor **79** into the condensate **97**. The baffles **83, 85** can comprise metal plates configured to provide a large surface area for condensing the vapor **79** into the condensate **97**. The baffles **83, 85** are also arranged in a pattern to permit the flow of the vapor **79** through the vapor recovery unit **69**, while at the same time providing surfaces areas for contacting and condensing the vapor **79**.

A first baffle **83** is oriented generally parallel to the flow of the vapor **79** (and to the ground), and is configured to intercept the vapor **79** as it enters the inlet **81** of the vapor recovery unit **69**. The other baffles **85** are arranged at different angles to the flow of the vapor **79** with from 45° to 90° being preferred. The vapor recovery unit **69** also includes a mist arrestor **89**, which can comprise screens, expanded metal, or a porous material such as intertwined metal strips similar to metal scrub pads for pots and pans. The mist arrestor **89** is configured to collect and condense the vapor **79** prior to exhausting of the hot air **93** from the exhaust stack **91**.

Fuzzy Logic Control System

The fuzzy logic control system **22** performs both "feedback control" and "feed forward control". The term "feedback control" means that the performance of the centrifuge **12** is evaluated by measuring the quality of the first liquid phase component **16** (oil), and optionally the quality of the second liquid phase component **18** (water). Input variables are then generated based on these measurements. The output of the centrifuge **12** is then adjusted based on the input variables and a set of fuzzy logic rules, and adjustments are made to optimize the performance of the centrifuge **12**.

The term "feed forward control" means the control system **22** anticipates future operation of the centrifuge based on input variables measured in the three phase mixture **14** (oil emulsion) prior to injection into the centrifuge **12**. The output of the centrifuge **12** is then predicted based on the input variables and additional fuzzy logic rules, and adjustments are made to optimize the performance of the centrifuge **12**.

In the illustrative embodiment the input variables for the "feedback control" are obtained by sensing the water and solids content of the first liquid phase component **16** (oil) which is termed herein the "Product Oil BS&W". The input variables for the feed forward control are obtained by sensing the cold feed temperature (T1), and the BS&W in the three phase mixture **14** (oil emulsion).

A first adjustment is the speed of the feed pump **24** which controls the feed rate of the three phase mixture **14** (oil emulsion). A second adjustment is the feed temperature set point (T2) of the three phase mixture **14** (oil emulsion). In this regard the fuzzy logic control system **22** sets the feed temperature set point (T2) and heater power is adjusted by the heater PID controller **27** to meet the set point requirements. These adjustments are made to optimize the quality of the first liquid phase component **16** (oil) which is termed in the rules to follow the "product oil".

Optionally, the control system **22** can be configured to also optimize the quality of the second liquid phase component **18** (water). The quality of the second liquid phase component **18** (water) is quantified by measuring its oil content, which is termed herein the "Product Water Oil Content". In the rules to follow, the "Product Water Oil Content" is considered and included in the software of the computer **100**. However, the control system **22** only contains sensors for measuring the "Product Oil BS&W" such that "Product Water Oil Content" is not measured and utilized.

Feedback Control System

The feedback control system **31** includes a feedback controller **104**, the PID controller **27** and the BS&W meter **33**. Optionally, the feedback control system **31** can include the water quality meter **35**. The feed back controller **104** is a program included in the computer **100** and programmed with a set of feedback control rules based on fuzzy logic.

The feedback control rules are of the form:

If the "Product Oil BS&W" is . . . and if the "Product Water Oil Content" is . . . Then the "Feed Rate Change" is and the "Feed Temperature Change" is . . .

Table 1 lists the rules.

TABLE 1

Rule No.	If (Product Oil BS & W) is	and (Product Water Oil Content) is	Then (Feed Rate Change) is	and (Feed Temperature Change) is
1	Very High	High	Negative Big	Positive Big
2	Very High	OK	Negative Big	Positive Big
3	High	High	Negative Big	Positive Big
4	High	OK	Negative Small	Positive Small
5	OK	High	Negative Small	Positive Small
6	OK	OK	Zero	Zero
7	Low	High	Zero	Zero
8	Low	OK	Positive Small	Negative Small

The input membership functions are shown FIGS. **2**A and **2**B. The output membership functions are shown in FIGS. **3**A and **3**B.

EXAMPLE 1

Suppose that the BS&W meter **33** (FIG. **1**) for the first liquid phase component **16** (oil) produced by the centrifuge **12**, and the water quality meter **35** (FIG. **1**) for the second liquid phase component **18** (water) produced by the centrifuge **12** measure the following values: product oil BS&W=0.75% and the percent oil in the product water=0.95%. FIGS. **2**A and **2**B are used to determine the input membership values obtained with these readings. In this example the BS&W reading of 0.75% has a membership of 0.25 in High and 0.75 in Very High. The percent oil in the product water of 0.95% has a membership of 0.10 in OK and 0.90 in High. FIGS. **3**A and **3**B can be used to determine the output membership functions where the shaded areas represent the clipped output membership functions.

In this example four of the eight rules in Table 1 are fired. The rules that have input variables with a membership of greater than zero are fired. These rules are one through four. Since four rules were fired, they must be combined in a logical fuzzy manner. The resolution rule used here was the min-max rule. In our example, the product oil BS&W has a membership of 0.75 in the fuzzy set, or membership function, Very High. It also has a membership of 0.25 in the set High. The oil in the product water has a membership of 0.90 in the set High and 0.10 in the set OK. All of the rules have two associated input membership values. The membership values for rule one are 0.75 for Very High BS&W in the product oil and 0.90 for High oil content in the product water. The minimum portion of the min-max rule causes this rule to be fired with the minimum value of 0.75. In a similar manner rule two is associated with the membership values of 0.75 and 0.10. It is fired with the minimum strength of 0.10. Rule three is associated with membership values of 0.25 and 0.90. It is fired with a minimum strength of 0.25. Rule four is associated with membership values of 0.25 and 0.10. It is fired with the minimum value of 0.10. The maximum portion of the min-max rule is used to determine the combination rule output or antecedent. Rules one through three have an antecedent of "Negative Big" for "Feed Rate Change and Positive Big for Feed Temperature Change". The strengths of these rules are 0.75, 0.10 and 0.25 respectively, as determined by the minimum portion of the min-max rule. The maximum value of 0.75 is used for the final value or strength of the combination of these three rules. The result is that the output membership function that describes the change in feed rate as "Negative Big", is truncated at the value of 0.75 as shown with the cross hatched portion of the leftmost triangle in FIG. **3**A. The same rule provides that the output membership function that describes the change in feed temperature as "Negative Big", is truncated at the value of 0.75 as shown with the cross hatched portion in the rightmost triangle in FIG. **3**B. Rule four is the only rule that suggests that the feed rate change should be "Negative Small" and the feed temperature change should be "Positive Small". It is fired with the strength of 0.10 as determined by minimum portion of the min-max rule. No maximum portion of the min-max rule is needed here since this is the only fired rule that has this antecedent. As shown in the FIGS. **3**A and **3**B, the membership functions that represent the change in feed rate of "Negative Small" and the change in feed temperature of "Positive Small" are truncated at a value of 0.10. The combination of the output of rules one through four is shown as the truncated membership functions in FIGS. **3**A and **3**B. The output values that are actually used are the centroids of these truncated figures. In this case about minus 1.457 barrels per hour (BPH) for the feed rate change and approximately plus 7.283° F. for the feed temperature change. The centroid values obtained from this calculation are converted to voltage signals and sent to the variable drive mechanism **44** for the feed pump **24**, and to the heater **26** to reduce the feed rate and increase the feed temperature accordingly.

There are several different techniques that are available for defuzzification. Since fuzzy logic is quite flexible, we have used the technique most appropriate for the problem we were addressing or most appropriate for the software we were working with, or simply the most convenient technique. Here, we have used the centroid of the truncated membership functions exactly as they appear in the figures. The centroid, or defuzzzified, value is given by equation.

(1).

$$\text{centroid} = \frac{\int f(x) x dx}{\int f(x) dx}$$

where f(x) is the function that describes the clipped membership function.

In this case it would be the function that describes the perimeter of the cross hatched areas in FIGS. **3**A and **3**B.

By examining the output membership shown in FIGS. **3**A and **3**B, it is noted that it is not possible to obtain the end-point values of +2 barrels per hour for the feed rate change of ±10° F. feed temperature change using the centroid technique. We can never get centroids of +2 or +10. In this example it doesn't matter. This was taken into account when building the membership functions.

EXAMPLE 2

In this example only the BS&W of the first liquid phase component **16** (oil) is considered. The control rules for this example are given in Table 2.

TABLE 2

Fuzzy rules for the feedback control system 31 without Oil in Product Water as an input variable

Rule No.	If (Product Oil BS & W) is	Then (Feed Rate Change) is	and (Feed Temperature Change) is
1	Very High	Negative Big	Positive Big
2	High	Negative Small	Positive Small
3	OK	Zero	Zero
4	Low	Positive Small	Negative Small

With the same product oil BS&W as in Example 1 (0.75%), rules **1** and **2** in Table 2 are fired with strengths of 0.75 and 0.25 respectively. The clipped output membership functions for this example are shown in FIGS. **4**A and **4**B. The centroids for these two figures are −1.293 and 6.524 respectively. The defuzzified control outputs are a "Feed Rate Change" of −1.293 BPH and a "Feed Temperature Change" of 6.524° F. These values are slightly different than the values of −1.457 BPH and 7.283° F. obtained in Example 1.

FIG. **5** illustrates a computer control screen **102** for the computer **100** of the fuzzy logic control system **22**. The screen, gives an operator instant access to all pertinent information. The current catch tank levels for the first liquid phase component **14** (oil) and the second liquid phase component **18** (water) are shown graphically. Important input and output variables are shown both with their current values in a digital format and an analog display as a strip chart showing their time history.

FIG. **4**C illustrates an actual output from a run using the rules in Table 2. In FIG. **4**C the variable under control, the product oil BS&W, is represented as a function of time.

Feed Forward Control System

As shown in FIG. **1**A, the feed forward control system **36** includes a feed forward controller **37**, a fuzzy soft sensor **38**, and a fuzzy SPC filter **34** configured to filter out sensor noise. The feed forward controller **37** processes large changes in the feed of the three phase mixture **14** (oil emulsion) that require process control adjustments before problems are encountered in the centrifuge **12**. The fuzzy soft sensor **38** includes and applies the fuzzy logic rules. The fuzzy SPC filter **34** differentiates between noise in the measured feed variables and a true change in the control variables (pump speed, heater power requirements). Accordingly, changes in the control variables are not made unless they are truly required. The fuzzy-SPC filter **34** filters out the sensor noise based on individual and moving range charts to be hereinafter described.

Referring to FIG. **6**A, the interaction of the feed forward loop for the feed forward control system **36**, and the feed back loop for the feedback control system **31** is illustrated in a block diagram. The feedback controller **104** is continually working, making adjustments to the feed rate and the feed temperature set point (T2). A conflict resolution portion **106** of the feedback controller **104** insures that corrections to the process due to both feedback and feed forward conditions are compatible with the goals of the feedback controller **104** and the feed forward controller **37** (FIG. **6**B). Feed forward events dominate because they are future events, and only significant events are acknowledged because of the fuzzy-SPC filter **34**. However, some weight is given to current events governed by the feedback controller **104**.

The feed forward computations **108** include computations from the fuzzy soft sensor **38** and from the feed forward controller **37**. This combination of computations is shown in FIG. **6**B. These computations require three input variables to determine what adjustments, if any, are required for the feed pump **24** and the feed temperature set point (T2). These variables are the cold feed temperature (T1), the percent change of water in the three phase mixture **14** (emulsion) and percent change of solid in the three phase mixture **14** (emulsion). Although the percentage change of water and solid is not measured directly, the change of BS&W in the three phase mixture **14** (emulsion) is the sum of the water and solid change. In addition, the change in power requirements for the heater **26** for maintaining a given set point temperature (T2) and the volumetric flow rate are measured. Based on these measurements, the feed BS&W measurements, and the cold feed temperature (T1) changes, we can determine the corresponding changes in the feed water and solid content. This is because of the knowledge programmed into the fuzzy soft sensor **38** in the form of fuzzy rules and membership functions.

Fuzzy-SPC Filter **34**

The fuzzy-SPC filter **34** is designed to prevent the feed forward controller **37** from acting upon feed changes that are really just noise in the sensors and the system. The fuzzy-SPC filter **34** is in the form of a program programmed into the computer **100**. The fuzzy-SPC filter **34** is an implementation of a fuzzy version of the statistical process control (SPC) charts known as Individual and Moving Range charts. FIG. **7**A is a Individual Chart and FIG. **7**B is a Moving Range chart.

FIGS. **7**A and **7**B were patterned after more commonly used X bar-R charts. These particular figures were developed using a computer model and a random number generator. In addition, we ordered the numbers produced by the random number generator in an attempt to simulate auto-correlated values. In the Chemical Process Industries, almost all samples taken from a continuous process are auto-correlated. This means the current sample is dependent upon the previous sample. Auto correlation raises some questions about theoretical concepts such as independence but the SPC version of this technique works quite well.

In the system **10** we have modified the SPC technique to include fuzzy logic. The reason for the modification is that the expert operator normally looks for indications that the feed BS&W has changed by a magnitude of at least +10% before implementing a manual feed-forward control. The fuzzy logic control system **22** can measure this with the feed BS&W meter **32**. However, this is not the whole story. The concentration of water and solids in the three phase mixture **14** (oil emulsion) can change in opposite directions, making the BS&W reading lower than +10%. The feed-forward controller **37** relies on knowledge of the water and solid changes individually, not the total BS&W change. The fuzzy soft-sensor **38** determines the magnitude of the individual water and solids changes from knowledge about feed pump flow changes and feed heater power requirement changes, in addition to the total feed BS&W change. The fuzzy-SPC filter **34** incorporates these three variables into a single variable that we call Feed-Magnitude-Change, and that is the value used with the SPC technique rather than just the feed BS&W change. In the system **10**, these changes can be developed in the field each workday at the beginning of the run after steady-state operation is achieved.

The Individual chart of FIG. **7**A, and the Moving Range chart of FIG. **7**B are constructed in the following manner:

- Data sets, comprising feed pump flow, heater power requirements, and feed BS&W, are taken at a specified sample interval (depending upon the current centrifuge operation-currently from about 10 seconds to about a minute). If a temperature change occurs the sample is corrected for temperature as will be more fully described.
- The differences in each succeeding set for the three variables are computed. These differences are called Variable Changes e.g., Feed BS&W Change.
- The Variable Changes are used with the rules in Table 3, the input membership functions in FIGS. **8**A, **8**B and **8**C, and the output membership functions in FIG. **9**, in the previously described manner to produce a variable call Feed-Change-Magnitude. This is the Individual variable that is plotted in FIG. **7**A.
- At each step, the difference between the current Feed-Change-Magnitude and the previous Feed-Change-Magnitude is computed. This is the Moving Range Value plotted in FIG. **7**B.
- After thirty sets (five minutes to half an hour), the Individual and the Moving Range averages are computed.
- The upper and lower control limits for the Individual charge (sometimes called the upper and lower natural limits, designated LNL and UNL, respectively in the FIG. **7**A), are computed from equations 2 and 3. The upper control limit for the Moving Range Chart (designated UCLr in FIG. **7**B) is computed from equation 4. These control limits are essentially three standard deviations above and below the mean or average lines.
- If the Individual values stray beyond the control limits, the "Feed-Change-Magnitude" is assumed to be significant and the fuzzy soft-sensor **38** and feed-forward controller **37** are implemented.
- If the Moving Range data go beyond the control limits, it usually means a rapid short-term change or that sensor difficulties are coming into play. The Moving Range chart (FIG. **7**B) is available to the operator, but currently no automatic control action is implemented based on Moving Range data.

$$UNL=\bar{X}+2.660\ \overline{\mathrm{mR}} \tag{2}$$

$$LNL=\bar{X}-2.660\ \overline{\mathrm{mR}} \tag{3}$$

$$UCLr=3.268\ \overline{\mathrm{mR}} \tag{4}$$

The terms UNL, LNL and UCLr are abbreviations for upper natural control limit, lower natural control limit, and upper control limit for the Moving Range, respectively. The symbol (X) is the Individual average (for thirty samples in this case), designated as Xbar in FIG. **7**A. The symbol (mR) is the Moving Range average, designated as Rbar in FIG. **7**B.

FIG. **7**A shows that the feed composition generated by the computer model does not stray beyond the control limits. This means that the fuzzy soft-sensor **36** and the feed-forward controller **37** would not be activated by any of the information generated by the computer model by this chart. However, the long-term trend indicated by point **12** through **16** might indicate that at that time the system was moving "out of control" and control action might soon be required.

In FIG. **7**B, the Moving Range chart, the point generated from sample number five is beyond the upper control limit. This comes from a rapid but small reverse in sign for the change in the feed BS&W. With actual data this could be an early warning of an impending feed composition change.

The "Feed-Change-Magnitude" is computed with a fuzzy rule based system. If we look at FIG. **6**B, we see that four input variables are used in the soft-sensor to compute two output variables, percent change in water, and percent change in solid. All four of those variables, cold feed temperature, feed flow rate, feed BS&W, and feed heater requirements, have associated random noise and are not independent. It is rather easy to correct for the cold feed temperature change. If necessary, the temperature correction is made and then the other three variables "Feed Flow Rate Change", "Feed BS&W Change", and "Feed Heater Requirement Change" are used with the fuzzy rule base to computer the "Feed-Magnitude-Change". As shown in Table 3, there are twenty-seven rules, three input variables, nine input membership functions, one output variable and five output membership functions in our fuzzy system. The rules are of the form:

If the "Feed Flow Rate Change" is . . . and the "Feed BS&W Change" is . . . and the "Feed Heater Requirement Change" is . . .

Then the "Feed-Change-Magnitude" is . . .

All of the input membership functions are ternary —"Positive", "Zero", and "Negative Changes". The output has five membership functions "Large Positive", "Small Positive", "Zero", "Small Negative", and "Large Negative". These membership functions are normalized between −1 and 1.

Other techniques are available for filtering the input and sensor noise. However, we feel the present technique is the best. It provides us with a technique for withholding a significant process change unless it is really needed. It provides us with a means to determine if the process feed is changing significantly. If the changes are slow enough they can be handled with the feedback system entirely. More abrupt changes will require the feed-forward system intervention. We can also determine changes in sensor noise and can determine in advance if we are having sensor problems. Note that once the initial control chart has been constructed (reasonably early into the run), we can sample and control as much as we want. The control charts are continually upgraded. The control chart upgrade goes on in the background.

The rules for the fuzzy-SPC filter are given in Table 3. The input membership functions are given in FIGS. **8**A–**8**C and the output membership functions are given in FIG. **9**.

TABLE 3

Rules for the fuzzy-SPC filter.

Rule Number	If (Feed Flow Rate Change) is	and (Feed BS & W Change) is	and (Feed Heater Requirement Change) is	Then (Feed-Change-Magnitude is
1	Negative	Negative	Negative	Large Negative
2	Negative	Negative	Zero	Large Negative
3	Negative	Negative	Positive	Small Negative

TABLE 3-continued

Rules for the fuzzy-SPC filter.

Rule Number	If (Feed Flow Rate Change) is	and (Feed BS & W Change) is	and (Feed Heater Requirement Change) is	Then (Feed-Change-Magnitude is
4	Negative	Zero	Negative	Large Negative
5	Negative	Zero	Zero	Zero
6	Negative	Zero	Positive	Zero
7	Negative	Positive	Negative	Large Positive
8	Negative	Positive	Zero	Large Positive
9	Negative	Positive	Positive	Small Positive
10	Zero	Negative	Negative	Large Negative
11	Zero	Negative	Zero	Small Negative
12	Zero	Negative	Positive	Large Negative
13	Zero	Zero	Negative	Small Negative
14	Zero	Zero	Zero	Zero
15	Zero	Zero	Positive	Small Positive
16	Zero	Positive	Negative	Small Positive
17	Zero	Positive	Zero	Small Positive
18	Zero	Positive	Positive	Large Positive
19	Positive	Negative	Negative	Large Negative
20	Positive	Negative	Zero	Large Negative
21	Positive	Negative	Positive	Large Negative
22	Positive	Zero	Negative	Small Positive
23	Positive	Zero	Zero	Small Positive
24	Positive	Zero	Positive	Large Positive
25	Positive	Positive	Negative	Small Positive
26	Positive	Positive	Zero	Large Positive
27	Positive	Positive	Positive	Large Positive

The upper and lower natural control limits shown in FIG. **7**A are 0.5449 and 0.5692, respectively. Currently, we are using these values as the controls limits or the bounds for a go or no-go decision on making a feed-forward control adjustment. We can use any value we want for the actual control limit, but unless we want too many "false alarms" the control limits should either be these limits or values outside of these limits. This system will need more turning once it is implemented in the field. But it works quite well with computer-generated numbers. The values in Table 4 represent some of the numbers generated by the simulation code in order to develop the rules and membership functions for the fuzzy soft-sensor. These numbers were randomly picked from the set of all numbers used. We can see from the last column in Table 4, Feed-Change-Magnitude, that all of these passed through the fuzzy-SPC filter as intended. All of the numbers in the last column are either greater than 0.5449 or less than −0.5692. Sample numbers six, eleven, and fourteen would not have passed the normal SPC filter test with our criterion of +10% change for the feed BS&W. The feed-forward controller **37** should act upon these samples since the individual feed water concentration and feed solid concentration varied significantly. The expert operator would normally detect these changes by noticing changes in the other process variables. In the manual mode he would probably make changes without thinking much about what he had observed. The automatic system that we have developed has to work with very carefully spelled out directions in order to make the same changes that the expert operator would.

TABLE 4

Simulated feed conditions and operating parameters with the computer Feed-Change-Magnitude that allowed passage through the fuzzy-SPG filter.

Sample Number	Flow Rate Change (gpm)	Feed BS & W Change (%) (%)	Heater Power Requirement Change	Percent Water Change	Percent Solid Change	Feed-Change-Magnitude
1	−0.9868	−15.0	−24.9072	−10.0	−5.0	−1
2	−0.9858	−10.0	−25.5324	−10.0	0.0	−1
3	−2.5944	−10.0	−60.7935	−15.0	5.0	−1
4	−0.5730	−10.0	−7.3806	0.0	−10.0	−0.7793
5	0.0909	10.0	0.0142	0.0	10.0	0.5611
6	1.1961	0.0	30.0429	10.0	−10.0	1
7	1.8378	10.0	42.6106	10.0	0.0	1
8	2.5513	20.0	58.5209	15.0	5.0	1
9	−1.3904	−15.0	−30.6755	−10.0	−5.0	−1
10	−2.3235	−15.0	−52.3410	−15.0	0.0	−1
11	−1.3890	0.0	−35.9500	−10.0	10	−1.0
12	0.8432	−10.0	14.2684	0.0	−10.0	−0.8963
13	−0.1294	10.0	−3.0514	0.0	10.0	0.5840
14	1.5198	5.0	33.7269	10.0	−5.0	1
15	1.7525	10.0	36.9448	10.0	0.0	1
16	0.9093	20.0	22.6764	10.0	10.0	1
17	−0.9084	−15.0	−23.7192	−10.0	−5.0	−1
18	1.2395	22.0	27.8453	10.0	12.0	1
19	0.7852	17.0	9.6989	0.0	17.0	0.8473
20	−0.2810	17.0	−12.1615	−5.0	22.0	0.6694

Fuzzy Feed Forward Controller **37**

The fuzzy feed-forward controller **37** is designed for disturbance rejection. The disturbances come in the form of feed disturbances. The feed disturbances that cause problems are cold feed temperature changes, that is, changes in the temperature of the three phase mixture **14** (oil emulsion) before it reaches the feed heater **26**, which cause changes in feed heater power requirements. The other disturbances that cause problems are changes in the feed BS&W. Knowledge of the change in the feed BS&W alone is not helpful. The variables that are meaningful are the changes in the percent water in the feed and changes in the percent solid in the feed. The sum of these two changes is equal to the change in the feed BS&W, which is the variable that we can measure. The fuzzy soft-sensor **36** uses the variables that we an measure, cold feed temperature, feed BS&W feed flow rate change, and feed heater requirements to predict the changes in the feed water and solid content. FIG. **6**B illustrates the combination of the feed-forward controller and the fuzzy soft sensor.

There are 27 rules, three input variables, nine input membership functions, two output variables, and six output membership functions. The rules are of the form: if "Feed Water Composition Change" is . . . and "Feed Solid Composition Change" is . . . and "Cold Feed Temperature Change" is. Then "Feed Pump Speed Change" is . . . and "Feed Heater Setpoint Change" is . . .

The feed-forward control rules are given in Table 5. The input membership functions are given in FIG. **10**A, FIG. **10**B and FIG. **10**C, and the output membership functions are given in FIG. **11**A and FIG. **11**B.

TABLE 5

The fuzzy rules for the feed-forward control system 36

Rule No.	if (Feed Water Composition Change) is	and (Feed Solid Composition Change) is	and (Cold Feed Temp. Change) is	Then (Feed Pump Speed Change) is	and (Feed Heater Change) is
1	Negative	Negative	Negative	Zero	Positive
2	Negative	Negative	Zero	Zero	Zero
3	Negative	Negative	Positive	Zero	Negative
4	Negative	Zero	Negative	Zero	Positive
5	Negative	Zero	Zero	Zero	Zero
6	Negative	Zero	Positive	Zero	Negative
7	Negative	Positive	Negative	Positive	Zero
8	Negative	Positive	Zero	Positive	Zero
9	Negative	Positive	Positive	Positive	Negative

TABLE 5-continued

The fuzzy rules for the feed-forward control system 36

Rule No.	if (Feed Water Composition Change) is	and (Feed Solid Composition Change) is	and (Cold Feed Temp. Change) is	Then (Feed Pump Speed Change) is	and (Feed Heater Change) is
10	Zero	Negative	Negative	Zero	Positive
11	Zero	Negative	Zero	Zero	Zero
12	Zero	Negative	Positive	Positive	Negative
13	Zero	Zero	Negative	Zero	Positive
14	Zero	Zero	Zero	Zero	Zero
15	Zero	Zero	Positive	Zero	Negative
16	Zero	Positive	Negative	Zero	Positive
17	Zero	Positive	Zero	Zero	Zero
18	Zero	Positive	Positive	Zero	Zero
19	Positive	Negative	Negative	Zero	Positive
20	Positive	Negative	Zero	Zero	Zero
21	Positive	Negative	Positive	Positive	Zero
22	Positive	Zero	Negative	Zero	Positive
23	Positive	Zero	Zero	Zero	Zero
24	Positive	Zero	Positive	Negative	Negative
25	Positive	Positive	Negative	Zero	Positive
26	Pasitive	Positive	Zero	Zero	Zero
27	Positive	Positive	Positive	Zero	Zero

EXAMPLE 3

When the sun goes down in the oil field, especially in the winter, temperatures often drop suddenly. This can cause the properties of the three phase mixture **14** (oil emulsion) to change, possibly leading to stratification in the feed receptacle **28**. Instead of a well-mixed feed, the operators experience feed "layers" with somewhat different properties. The property changes affect the operation of the centrifuge **12**. For this example we assume that the cold feed temperature charge (T1) is measured as −4° F. We assume that the fuzzy soft-sensor **36** detects a change in the feed solid content of +2% and a change in the feed water content of +6%. From FIG. **10**A, the change in feed water content has a membership of 0.3 in "Positive" and 0.7 in "Zero". From FIG. **10**B, the change in feed solid content has a membership of 0.2 in "Positive" and 0.8 in "Zero". From FIG. **10**C, the change in cold feed temperature has a membership of 0.6 in "Zero" and 0.04 in "Negative". From Table 5, eight rules are fired. The rules fired are **13**, **14**, **16**, **17**, **22**, **23**, **25**, and **26**. These rules, with their Min-Max resolution are shown in Table 6. In Table 6 "P", "Z", and "N" stand for "Positive", "Zero", and "Negative" respectively.

TABLE 6

The rules fired for Exam le 3 with thpir resolution.

	If (Feed Water Composition Change) is	and (Feed Solid Composition Change) is	and (Cold Feed Temp. Change) is	Then (Feed Pump Speed Change) is	and Feed Heater Setpoint Change) is
			Input		
Rule No./Value	+6% Membership	+2% Membership	−4° Membership	— Minimum	— Minimum
13	Z (0.7)	Z (0.8)	N (0.4)	Z (0.4)	P (0.4)
14	Z (0.7)	Z (0.8)	N (0.6)	Z (0.6)	Z (0.6)
16	Z (0.7)	P (0.2)	N (0.4)	Z (0.4)	P (0.2)
17	Z (0.7)	P (0.2)	Z (0.6)	Z (0.2)	Z (0.2)

TABLE 6-continued

The rules fired for Exam le 3 with their resolution.

Rule No./Value	If (Feed Water Composition Change) is	and (Feed Solid Composition Change) is	and (Cold Feed Temp. Change) is	Then (Feed Pump Speed Change) is	and Feed Heater Setpoint Change) is
			Input		
	+6% Membership	+2% Membership	−4° Membership	— Minimum	— Minimum
22	P (0.3)	Z (0.8)	N (0.4)	Z (0.3)	P (0.3)
23	P (0.3)	Z (0.8)	Z (0.6)	Z (0.3)	Z (0.3)
25	P (0.3)	P (0.2)	N (0.4)	Z (0.2)	P (0.2)
26	P (0.3)	Z (0.2)	Z (0.6)	Z (0.2)	Z (0.2)
Maximum Values				Z = 0.6	P = 0.4 Z − 0.6

P = Positive,
Z = Zero,
N = Negative

The rules fired, as shown in Table 3, provide Output 0.4 values of 0.6 for Zero for Feed Pump Speed Change and 0.6 and 0.4 respectively for Positive and Zero for Feed Heater Setpoint Change. The corresponding clipped output memberships functions are shown in FIGS. **11**A and **11**B.

The centroid of the shaded area in FIG. **11**A is 0.0. Therefore the computed Feed Pump Speed Change is zero for this example. The centroid of the shaded area of FIG. **11**B is 4.19. Therefore the computer Feed Heater Setpoint Change is 4.19° F. for this example.

Fuzzy Soft Sensor **38**

The basic rules for the fuzzy soft sensor **38**, are listed in Table 7. Although these rules are illustrative, they can be supplemented or changed using techniques disclosed in the present application.

These rules are of the form:

If the "Feed Pump Flow Change" is . . . and the "Feed BS&W Change" is . . . and the "Feeder Heater Power Requirement" is . . . Then the "Feed Water Change" is . . . and the "Feed Solid Change" is . . .

TABLE 7

The basic rules for the fuzzy soft sensor 36.

Rule #	If (Feed Pump Flow Change) is	& Feed (BS & W Change) is	& (Heater Power Requirememt Change) is	Then (Feed Water is	& (Feed Solid Change) is
1	Large Negative	Negative	Negative	Negative	Negative
2	Large Negative	Negative	Zero	Negative	Positive
3	Large Negative	Negative	Positive	Negative	Positive
4	Large Negative	Zero	Negative	Zero	Zero
5	Large Negative	Zero	Zero	Negative	Positive
6	Large Negative	Zero	Positive	Negative	Positive
7	Large Negative	Positive	Negative	Positive	Positive
8	Large Negative	Positive	Zero	Negative	Positive
9	Large Negative	Positive	Positive	Zero	Positive
10	Small Negative	Negative	Negative	Negative	Negative
11	Small Negative	Negative	Zero	Negative	Negative
12	Small Negative	Negative	Positive	Negative	Positive
13	Small Negative	Zero	Negative	Zero	Zero
14	Small Negative	Zero	Zero	Zero	Zero
15	Small Negative	Zero	Positive	Negative	Positive
16	Small Negative	Positive	Negative	Zero	Positive
17	Small Negative	Positive	Zero	Positive	Positive
18	Small Negative	Positive	Positive	Positive	Positive
19	Zero	Negative	Negative	Negative	Negative
20	Zero	Negative	Zero	Zero	Negative
21	Zero	Negative	Positive	Positive	Negative
22	Zero	Zero	Negative	Zero	Zero
23	Zero	Zero	Zero	Zero	Zero
24	Zero	Zero	Positive	Positive	Negative
25	Zero	Positive	Negative	Zero	Negative
26	Zero	Positive	Zero	Positive	Positive
27	Zero	Positive	Positive	Positive	Positive
28	Small Positive	Negative	Negative	Negative	Zero
29	Small Positive	Negative	Zero	Negative	Negative
30	Small Positive	Negative	Positive	Zero	Negative
31	Small Positive	Zero	Negative	Zero	Zero

TABLE 7-continued

The basic rules for the fuzzy soft sensor 36.

Rule #	If (Feed Pump Flow Change) is	& Feed (BS & W Change) is	& (Heater Power Requirememt Change) is	Then (Feed Water is	& (Feed Solid Change) is
32	Small Positive	Zero	Zero	Zero	Zero
33	Small Positive	Zero	Positive	Zero	Zero
34	Small Positive	Positive	Negative	Zero	Positive
35	Small Positive	Positive	Zero	Negative	Positive
36	Small Positive	Positive	Positive	Positive	Zero
37	Large Positive	Negative	Negative	Negative	Negative
38	Large Positive	Negative	Zero	Negative	Negative
39	Large Positive	Negative	Positive	Positive	Negative
40	Large Positive	Zero	Negative	Zero	Zero
41	Large Positive	Zero	Zero	Zero	Zero
42	Large Positive	Zero	Positive	Positive	Negative
43	Large Positive	Positive	Negative	Zero	Positive
44	Large Positive	Positive	Zero	Positive	Positive
45	Large Positive	Positive	Positive	Positive	Negative

In order to implement the above rules, crisp rules and a branch and bound technique can be used to choose the rules that will be used for a given condition. For example we can obtain **27** branch points from the original **45** rules. The desired branch point is chosen using "crisp" values of the input variables "Pump Flow Change", "BS&W Change", and "Heater Power Requirement Change". From the branch point we step to a fuzzy control routine that manages the fuzzy rules under the branch. The crisp rules for the 27 branch points are listed in Table 8. These rules are of the form:

If "Pump Flow Change" is . . . and "BS&W Change" is . . . and "Heater Power Requirement" is . . . then Go to . . .

TABLE 8

Branch points for the fuzzy soft sensor rule base.

Branch point	if (Pump Flow Change) is	and (BS & W Change) is	and (Heater Power Requirement Change) is	Then (GO to . . .)
1	Negative	Negative	Negative	Fuzzy system 1
2	Negative	Negative	Zero	Fuzzy system 2
3	Negative	Negative	Positive	Fuzzy system 3
4	Negative	Zero	Negative	Fuzzy system 4
5	Negative	Zero	Zero	Fuzzy system 5
6	Negative	Zero	Positive	Fuzzy system 6
7	Negative	Positive	Negative	Fuzzy system 7
8	Negative	Positive	Zero	Fuzzy system 8
9	Negative	Positive	Positive	Fuzzy system 9
10	Zero	Negative	Negative	Fuzzy system 10
11	Zero	Negative	Zero	Fuzzy system 11
12	Zero	Negative	Positive	Fuzzy system 12
13	Zero	Zero	Negative	Fuzzy system 13
14	Zero	Zero	Zero	Fuzzy system 14
15	Zero	Zero	Positive	Fuzzy system 15
16	Zero	Positive	Negative	Fuzzy system 16
17	Zero	Positive	Zero	Fuzzy system 17
18	Zero	Positive	Positive	Fuzzy system 18
19	Positive	Negative	Negative	Fuzzy system 19
20	Positive	Negative	Zero	Fuzzy system 20
21	Positive	Negative	Positive	Fuzzy system 21
22	Positive	Zero	Negative	Fuzzy system 22
23	Positive	Zero	Zero	Fuzzy system 23
24	Positive	Zero	Positive	Fuzzy system 24
25	Positive	Positive	Negative	Fuzzy system 25

TABLE 8-continued

Branch points for the fuzzy soft sensor rule base.

Branch point	if (Pump Flow Change) is	and (BS & W Change) is	and (Heater Power Requirement Change) is	Then (GO to . . .)
26	Positive	Positive	Zero	Fuzzy system 26
27	Positive	Positive	Positive	Fuzzy system 27

FIG. **12** illustrates the use of the Table 8

The soft sensor rules (**1–27**) currently are all different. Some are very simple and some are reasonably complicated, using many of the original **45** rules with modified membership functions. In addition to the variables shown above, Feed BS&W, Feed Pump Flow, and Heater Power Requirement, Feed Temperature Change are taken into account. As well, each rule system must take into account whether the continuous phase is oil or water. If water is the continuous phase, oil droplets are dispersed throughout the water phase. If oil is the continuous phase water droplets are dispersed through the oil phase. The physical properties of the system, especially viscosity, strongly depend upon which phase is the continuous one.

Thus the invention provides an improved system and process for separating a multi chase mixture into separate components. Although the invention has been described with reference to certain preferred embodiments, as will be apparent to those skilled in the art, certain changes and modifications can be made without departing from the scope of the invention as defined by the following claims.

We claim:

1. A system for separating a multi phase mixture comprising:

a centrifuge configured to separate the mixture into a first liquid phase component, a second liquid phase component and a solid phase component; and

a control system programmed with a set of fuzzy logic rules;

the control system configured to sense feed variables of the mixture into the centrifuge and at least one parameter of the first liquid phase component or the second

liquid phase component and to adjust a feed temperature and a feed rate of the mixture based on the variables, the parameter and the set of fuzzy logic rules.

2. The system of claim **1** wherein the control system further comprises a filter configured to differentiate signals representative of the feed variable from noise.

3. The system of claim **1** wherein the control system further comprises a conflict resolution portion configured to resolve conflicts during adjusting of the feed temperature and the feed rate.

4. The system of claim **3** wherein the mixture comprises an oil emulsion, the first liquid phase component comprises oil and the second liquid phase component comprises water.

5. A system for separating a multi phase mixture comprising:

a centrifuge configured to separate the mixture into a first liquid phase component, a second liquid phase component and a solid phase component;

a feed forward control system comprising a plurality of sensors, a fuzzy soft sensor in signal communication with the sensors programmed with a set of fuzzy logic rules, and a controller in signal communication with the fuzzy soft sensor,

the feed forward control system configured to sense feed variables of the mixture into the centrifuge and to adjust a feed temperature and a feed rate of the mixture based on the feed variables and the set of fuzzy logic rules; and

a feedback control system configured to measure feedback variables in the first liquid phase component or the second liquid phase component and to adjust the feed temperature and the feed rate based on the feedback variables and the set of fuzzy logic rules;

the feedback control system comprising a feedback controller including a conflict resolution portion configured to coordinate the operation of the controller and the feedback controller.

6. The system of claim **5** wherein the feedback control system includes a BS&W sensor configured to measure a basic solids and water content of the first liquid phase component and to adjust the feed temperature and the feed rate based on the basic solids and water content and the set of fuzzy logic rules.

7. The system of claim **5** wherein the feed variables include a feed temperature and a feed rate.

8. The system of claim **5** wherein the feed variables include a feed temperature, a feed rate, a percent change of water and a percent change of solid expressed as a single feed magnitude change variable.

9. A system for separating a multi phase mixture comprising:

a centrifuge configured to separate the mixture into a first liquid phase component, a second liquid phase component and a solid phase component;

a feed forward control system comprising a plurality of sensors, a fuzzy soft sensor in signal communication with the sensors programmed with a set of fuzzy logic rules, and a controller in signal communication with the fuzzy soft sensor,

the feed forward control system configured to sense feed variables of the mixture into the centrifuge and to adjust a feed temperature and a feed rate of the mixture based on the feed variables and the set of fuzzy logic rules; and

a filter in signal communication with the fuzzy soft sensor configured to differentiate signals representative of the feed variables from noise.

10. The system of claim **9** further comprising a heater in signal communication with the controller configured to heat the mixture to the feed temperature and a pump in signal communication with the controller configured to pump the mixture into the centrifuge at the feed rate.

11. The system of claim **9** wherein the mixture comprises an oil emulsion, the first liquid phase component comprises oil and the second liquid phase component comprises water.

12. A system for separating a multi phase mixture comprising:

a centrifuge configured to separate the mixture into a first liquid phase component, a second liquid phase component and a solid phase component;

a heater configured to heat the mixture to a temperature set point (T2);

a pump configured to pump the mixture into the centrifuge;

a fuzzy soft sensor in signal communication with a first sensor configured to sense a feed temperature (T1) of the mixture and a second sensor configured to sense a basic solids and water content of the mixture;

a set of fuzzy logic rules programmed into the fuzzy soft sensor and configured to express input from the first sensor and the second sensor into at least one feed change variable; and

a controller in signal communication with the fuzzy soft sensor configured to adjust the temperature set point (T2) for the mixture, and to adjust a speed of the pump to achieve a selected feed rate for the mixture.

13. The system of claim **12** further comprising a third sensor configured to measure a basic solids and water content of the first liquid phase component, and a feedback controller in signal communication with the third sensor configured to adjust the temperature set point (T2) and the speed of the pump based on the rules and input from the third sensor.

14. The system of claim **12** wherein the mixture comprises an oil emulsion, the first liquid phase component comprises oil and the second liquid phase component comprises water.

15. The system of claim **12** wherein the centrifuge comprises a rotatable bowl for separating the first liquid phase component and the second liquid phase component and an auger for separating the solid phase component.

16. The system of claim **12** wherein the centrifuge includes a tank configured to collect the first liquid phase component and a vapor recovery unit configured to collect and condense vapor from the tank.

17. The system of claim **16** wherein the vapor recovery unit comprises a fan configured to move the vapor and a plurality of baffles configured to condense the vapor.

18. The system of claim **12** wherein the rules are in an "if" "then" format.

19. A process for separating a multi phase mixture comprising:

providing a centrifuge configured to separate the mixture into a first liquid phase component, a second liquid phase component and a solid phase component; and

providing a fuzzy soft sensor programmed with a set of fuzzy logic rules;

sensing at least one feed variable of the mixture and at least one parameter of the first liquid chase component or the second liquid phase component; and

adjusting a feed temperature and a feed rate of the mixture into the centrifuge based on the feed variable, the parameter and the set of fuzzy logic rules.

20. The process of claim **19** wherein the feed variable is selected from the group consisting of the feed temperature, a percent change of water and a percent change of solid of the mixture.

21. The process of claim **19** wherein the feed variable comprises a percent change of solid expressed as a single feed magnitude change variable.

22. The process of claim **19** further comprising resolving conflicts from the sensing step prior to performing the adjusting step.

23. The process of claim **19** wherein the mixture comprises an oil emulsion, the first liquid phase component comprises oil and the second liquid phase component comprises water.

24. A process for separating a multi phase mixture comprising:

providing a centrifuge configured to separate the mixture into a first liquid phase component, a second liquid phase component and a solid phase component;

providing a feed pump configured to pump the mixture into the centrifuge at a feed rate;

providing a heater configured to heat the mixture to a temperature set point;

providing a fuzzy soft sensor programmed with a set of fuzzy logic rules that relate a feed water composition change of the mixture, a feed solid composition change of the mixture, and a cold feed temperature change of the mixture to a feed pump speed change for the feed pump, and to a heater setpoint change for the heater;

sensing the basic solids and water content of the mixture and the cold feed temperature;

filtering signals representative of the basic solids and water content and the cold feed temperature from noise;

relating the basic solids and water content to the feed water composition change and to the feed solid composition change; and

adjusting the feed rate and the temperature set point using the rules, the sensing step, the filtering step and the relating step.

25. The process of claim **24** wherein the mixture comprises an oil emulsion, the first liquid phase component comprises oil and the second liquid phase component comprises water.

26. The process of claim **24** further comprising sensing a basic solids and water content of the first liquid phase component to provide feedback data and adjusting the feed rate and the temperature set point using the feedback data.

27. The process of claim **24** further comprising sensing an oil content of the second liquid phase component to provide additional feedback date and adjusting the feed rate and the temperature set point using the additional feedback data.

28. The process of claim **24** further comprising collecting the first liquid phase component in a tank, collecting the vapor from the tank, and condensing the vapor.

29. The process of claim **28** further comprising providing a vapor recovery unit comprising a fan configured to move the vapor and a plurality of baffles configured to condense the vapor.

* * * * *

SECTION FIVE

ATTACHMENT NO. **3**
EQUIPMENT DETAILS

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644

3444 Burd Road, Casper, Wyoming 82601

Equipment List

	ITEM NAME
1	Patented Three-Phase Centrifuge
2	Muvall 40ft. Loboy Trailer/with heater control/power cords & vfd drives (platform for centrifuge)
3	2-L6 pc Pumps
4	2-L8 pc Pumps
5	Catch Tank/with piping valve fittings
6	125KW Submergible Electric Heater
7	Vapor Recovery System
8	200ft 2" Hose/300ft 4" Hose
9	Winterizing Frame Work & Tarps
10	Three F350 Crew Cabs
11	545D Ford Tractor Loader
12	Pace 28ft Decon/Trailer
13	Superior 28ft Gooseneck Trailer
14	40ft Semi/Trailer Storage
15	SA200 Lincoln Welder
16	Miller Wirefeed Welder
17	Hotsy High Pressure Washer (steamer)
18	Ridge Drill Press
19	Makita 14" Chop Saw
20	Misc Power & Hand Tools
21	Heavy Jack
22	Multiple Electric Motors (heavy duty)
23	Gas Bottles
24	Radio Unit #1
25	Fire Extinguishers & Safety Equipment
26	Tractor/Backhoe
27	Control Panel
28	Welding Machine
29	Heater
30	Centrifuge Electric & Spare Parts
31	Control House
32	Sub Electric Heater (125KW)
33	545D Tractor (Ford)
34	28 Foot Decontamination Trailer
35	28 Foot Gooseneck Trailer
36	Crew cab 4xy F 350 Pickup Trucks (4)
37	Satellite telephone (1)

Centech's Neil Miller
Winner of R&D 100 Award
for
Three-Phase Centrifuge
Technology

R&D 100 Awards Archive

Your Search Results forCompany Name: Centech

Company	Product Category	Product Name	Developer	Award Year
Centech	Environmental Research	Centech Three Phase Type I	Neal Miller	1993
1				

Search Again Return to R&D Magazine

Dateline: Los Alamos

BRIEFLY ...

LABORATORY FORMS NEW OFFICE TO ENHANCE COLLABORATIONS. Two Los Alamos programs, the office of Energy Technology and the Industrial Partnership Office, have merged into a single program called the Civilian and Industrial Technology Program Office. The merger will enhance the Laboratory's role in civilian federal programs such as fossil fuel and energy efficiency technologies and will work to form synergistic partnerships with industry sectors closely aligned with those civilian programs. Additionally, the office will seek to form strategic partnerships with industry that provide value to the Laboratory in terms of innovation and the ability of the partnership to enhance the Lab's ability to meet its core mission. The new office will more closely scrutinize Los Alamos' areas of science and technology that will benefit from the industrial collaboration and analyze the long-term benefits. "We'll be looking for programs and partnerships, in either industry or government, where the results of the work will help strengthen and revitalize the Laboratory's role in non-defense federal and civilian programs," said Charryl Berger, director of the new office. "We will focus on innovation and creativity rather than the amount of money the collaboration might bring in."

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IN THIS ISSUE:

Dateline: Los Alamos is available on the World Wide Web: http://lib-www.lanl.gov/pubs/dateline.htm

DATELINE LOS ALAMOS

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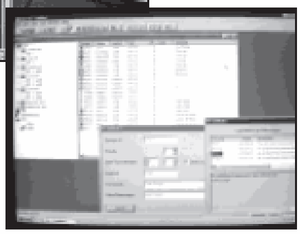
LALP-97-1-9

Los Alamos NATIONAL LABORATORY

DATELINE: LOS ALAMOS

AUTOMATED CHEMICAL ANALYSIS SYSTEM

The Automated Chemical Analysis System processes soil samples for the detection and determination of polychlorinated biphenyl mixtures: hazardous chemicals originally used as heat-transfer fluids. These so-called "PCBs" are a significant contaminant at a number of government and industrial sites. Not only do PCBs have great chemical stability, they are also a potential carcinogen and the Environmental Protection Agency wishes to eliminate them from the environment. Los Alamos is leading a national laboratory effort that includes Oak Ridge, Sandia, Pacific Northwest, and Idaho Engineering to process soil samples for the detection and determination of PCB mixtures using the Automated Chemical Analysis System. Transported to the contaminated site in an 18-wheel semitrailer truck, the system uses standardized modules to provide consistent and reproducible analytical results. Individual modules can be removed or added to the system. This built-in flexibility eventually will allow scientists to conduct myriad analyses for applications that range from environmental cleanup and waste management to food and pharmaceutical characterization and petrochemical processing.



The Automated Chemical Analysis System consists of several integrated Standard Laboratory Modules. A robot arm transports a sample from module to module. The inset at right shows the Human-Computer Interface software module used to automate an entire chemical analysis.

CONTACT: ROBERT HOLLEN

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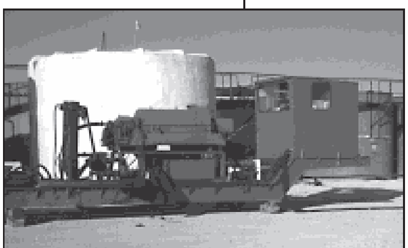
AUTOMATICALLY CONTROLLED THREE-PHASE CENTRIFUGE

A centrifuge operating at a waste disposal site for oil fields. The tanks contain sludge that has been left over by other cleaning methods. The sludge is separated into pipeline-quality oil, reusable water, and harmless solids.



Approximately 100 million barrels of environmentally hazardous oil sludge must be cleaned up in the United States alone, and more than 2.5 million barrels are discarded annually. Worldwide, the figures are much higher. Much of this oil sludge comes from refineries, but a large portion is a byproduct of oil field production. Los Alamos and Centech Inc. of Casper, Wyo., have combined an

ingeniously designed centrifuge and an intelligent "fuzzy" controller. Computer software with fuzzy intelligence makes decisions based on a construct of rules that captures the expertise and experience of a highly skilled human operator. The fuzzy software substantially improves an already successful centrifuge technology by automating control of the centrifuge for environmental cleanup and oil recovery. The automatically controlled three-phase centrifuge will separate oil field and oil refinery wastes into salable oil, reusable water, and harmless solids. It will efficiently clean up oil spills that cause serious environmental problems and it can also be used in separation processes conducted by the steel industry.

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SECTION FIVE

ATTACHMENT NO. 4
AUDITED FINANCIAL STATEMENT

A current audited financial statement for Centech International LLC is not available.

Since Centech International LLC is a Kuwait owned Company a Parent Company Guarantee is provided in lieu of an audited financial statement in APPENDIX - 1

SECTION FIVE

ATTACHMENT NO. 5
OTHER FINANCIAL DATA

NOT APPLICABLE

KUWAIT OIL COMPANY (K. S. C.)

PRE-QUALIFICATION

FOR

"WASTE MANAGEMENT SERVICES"
(PQ-06/05)

APPENDIX - I

PARENT COMPANY GUARANTEE

M/s Kuwait Oil Company (K.S.C.)
Kuwait

Subject: **PQ 06/05 PRE-QUALIFICATION FOR "WASTE MANAGEMENT SERVICES"**

PARENT COMPANY GUARANTEE

THIS GUARANTEE is made this 2nd day of December 2007. We, Oil Field Technologies & Environmental Services Co. a company incorporated in Kuwait having its registered office at State of Kuwait, P.O. Box 4464 Safat 13045 Kuwait (Hereinafter called the "Guarantor" and may also be referred as "Parent Company")

and

Centech International LLC a company incorporated in Delaware having its registered office in the State of Delaware. 2711 Centerville Road, Suite 400 Wilmington, Country of New Castle, Delaware 19808 (Hereinafter called the "Contractor" and may be also referred as the "Subsidiary")

WHEREAS

A. The Kuwait Oil Company ("Company") may enter into a contract for the execution of **WASTE MANAGEMENT SERVICES.** In this connection the Company has conducted a pre-qualification exercise and invited international contractors with the required experience to participate in a pre-qualification exercise for possible inclusion in the Company's approved list of contractors to be invited for bidding for the above said Services.

B. The Contractor being a contractor specialized in the required Services has applied to be pre-qualified and listed on the Company's approved list of contractors for the Services.

C. The Guarantor being the Parent Company of the Contractor, has agreed that it shall to the extent hereinafter set forth unconditionally and irrevocably guarantee the due performance by the Contractor of all it's obligations under the contract with the Company to provide the Services if entered into between the Contractor and the Company.

info@oteskuwait.com www.oteskuwait.com الكويت 1305 الصفاة 4464 ص . ب (965) 2404500 : فاكس (965) 2402929 - (965) 2402828 :تلفون
(965) 2402828 - (965) 2402929 Fax: (965) 2404500 P.O.Box 4464 Safat 1305 - Kuwait info@oteskuwait.com www.oteskuwait.com State of Kuwait

NOW THEREFORE it is hereby agreed:

1. The Guarantor unconditionally and irrevocably guarantees the due and proper performance and observance by the Contractor of all of the Contractor's obligations under the contract that may be entered into with the Company to perform the required Services.

2. The Guarantor shall indemnify the Company against all losses, damage, costs and expenses which Company may incur by reason of such breach by the Contractor except that in no event shall the Guarantor have a greater liability in relation to such breach than the Contractor.

3. That on being directed to do so by the Company by notice in writing the Guarantor shall perform or take whatever steps may be necessary to procure/provide the performance of the obligations of the Contractor under the contract for the Services and shall from the date of such notice assume jointly and severally with the Contractor all the rights and obligations under the contract in every way as if the Guarantor were a party to the Contract.

4. The Guarantor shall not be discharged or released from his Guarantee by any arrangement made between the Contractor and the Company under any contract or by any forbearance such as payment, extension of time for any amendment to the contract, performance, or otherwise even though such arrangement, alteration or forbearance may be without the assent of the Guarantor.

5. This Guarantee shall be construed and governed in accordance with the laws of State of Kuwait.

6. This Guarantee has no time period, it shall continue until all of the obligations of the Contractor under the contract entered into between the Company and the Contractor has been completely performed to the satisfaction of the Company, and the Guarantor shall not be released of any obligation or liability until any outstanding claim by the Company against the Contractor under the related contract has been settled in full.

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7. This Guarantee shall be construed in accordance with the normal usage of English Language.

SIGNED by "Name"	:	Mohammed Hamoud Al Muharreb Al Hamoud
Capacity	:	Chairman
for and on behalf of	:	Oil Field Technologies & Environmental Services Co.
"Guarantor"		Oil Field Technologies & Environmental Services Co.

SIGNED by "Name"	:	Ernest W. Alexander
Capacity	:	Managing Director
for and on behalf of	:	Centech International LLC.
"Contractor"		Centech International LLC

Centech International LLC
P.O. Box 2170, Mills, Wyoming 82644
3444 Burr Road, Casper, Wyoming 82601

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SECTION SIX

Part **1**

Signed CORPORATE HSE POLICY

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

CORPORATE HSE POLICY

Protection and Management

Centech International (CI) has developed an HSE-MS that integrates environmental policies and standards, planning, training, communications, documentation, assessment, compliance audit services, and management review processes, to achieve superior environmental performance while supporting our main principles of protection, compliance, conservation, and communications.

Centech International has HSE staff / teams that specialize in the following areas and detailed descriptions of the roles and responsibilities of each function:

- **Environmental Protection (EP)** – provides environmental policies, tools, training, and strategic advice
- **Groundwater Protection (GP)** – resolves groundwater issues and ensures groundwater monitoring networks are implemented to specifications
- **Environmental Engineering (EE)** – manages the planning, design and operation of our remediation technique(s) and processes
- **Air/Gas Management (AGM)** – develops policies and standards as well as the planning and develop of air quality and gas management tools
- **Laboratory Services Program (LS)** – manages risks associated w/the analytical testing of environmental samples
- **Health & Safety (HS)** – develops/implements policies, standards, and procedures that address health/safety concerns to ensure quality environmental performance, protection, and compliance

Centech International HSE Policies and Standards

- Occupational Safety and Health Policy
- Hazard Identification, Risk Assessment and Risk Control Policies
- Air/Gas Management Policies
- Groundwater and Related Media Management Policies
- Pollution Prevention Policy
- Environmental Management Technology Procedure
- Sampling & Waste Analysis Procedures
- Chemical Hazards Safety Policy
- Decontamination Procedures
- Remediated-Product Use Procedures
- HSE Audit Process Procedures

Corporate HSE Planning

Regulatory and business requirements applicable to our operations are determined using the following tools:

- Environmental regulatory updates (federal, state, and local)
- Compliance software and tools ('fuzzy logic')
- Corporate management practices / industry standards
- Corporate environmental policies and standards

In addressing issues affecting regional and local operations, we review and consider the following documents and tools in planning:

- State and local regulatory changes
- Local environmental programs and procedures
- Self-assessments
- Local training programs
- Group compliance tools (manuals and group guidance documents)

HSE Training

Health, Safety, & Environmental training targets a range of operational and functional levels within the company. All new employees participate in corporate ethics and compliance training, which outlines Centech International's (CI's) global standards for HSE practices. Employees that have responsibility for environmental leadership are trained in the company's environmental practices. Topic specific environmental training is developed and implemented by corporate and group HSE teams.

Training tools include the following:

- Environmental protection training
- Annual environmental technical conferences
- Technical seminars

In addition to the tools identified above, local training is provided through the following:

- Group in-house classroom training
- On-the job training
- Out-sourced training

HSE Program Communications

Communication is vital to ensuring environmental issues are part of everyday activities at WM and communicating performance to our customers, communities, regulators and investors strengthens our ability to be an industry leader.

We communicate within our company and (with our communities, customers, regulators and investors) using:

- (weekly newsletter) - update employees on environmental and operations activities.

- www.oteskuwait.com (corporate website) - highlights significant research, environmental awards, and unique achievements in environmental management

- CI's environmental scientists and professionals - present achievements and research at national and international environmental conferences
- CI's Corporate Communications department
- CI's local management support community outreach

HSE Program Documentation

CI has a corporate & site section (environmental protection (EP), which is a central location for all environmental documentation and is available to all CI employees. The primary supporting documents include policies, standards and training materials.

HSE Program Management Review

Various CI management personnel participate in the management review process to determine the level of success in achieving health, safety, & environmental goals. They:

- Review environmental policies on a routine basis
- Review the design of the HSE program to determine if the system is capable of achieving our HSE policy goals and fully supporting principles of protection, compliance, conservation and communication
- All revisions to the HSE program document and supporting policies are documented and retained by the corporate environmental protection section
- Conduct a formal annual review of HSE program
- Review the local performance measures, goals and objectives
- Review local issues on a schedule throughout the year
- Amend the HSE program, including policies, procedures and practices on a timely basis whenever the systematic evaluations indicate that changes could improve our ability to protect the environment

Management Systems
Management Systems provide the foundation for a consistently effective HSE process; guidance and direction for employees and organizations; expectations that are understood; and a method of controlling occupational injuries / illnesses, environmental incidents and costs.

HSE Management Systems
▶ Management Commitment & Direction
▶ Employee Roles and Responsibility
▶ Hazard Control & Risk Assessment
▶ Laws and Regulations
▶ Education and Training
▶ HSE Communication
▶ Rules & Procedures
▶ Emergency Planning and Medical Surveillance
▶ Documents & Records
▶ Contractor and Vendor (Supplier) Management
▶ Product Safety
▶ Security & Travel Safety
▶ Audit and Inspections
▶ Incident Investigation & Reporting
▶ Process Assessment & Improvement

HSE Management Systems Audit Process

- Opening Conference
- Executing the HSE Management Systems Audit
  - ✓ reviewing the site's existing HSE process
  - ✓ evaluate how the site is executing CI's HSE Management Systems
  - ✓ interview employees at all levels of the organization; and verify and provide recommendations to improve the site's HSE process
- Put together "DRAFT" report and score
- Closing Conference
- Six (6) month follow-up reviews

HSE Management System Audit Scoring

Each HSE Management System element receives a score. This helps the site prioritize their resources and what to focus on first.

The site receives an overall Audit score. This provides the site with a baseline of how well they are executing Centech International HSE Management Systems.

Scores are also being used to validate our Safety Management Systems -- (score compared to site performance)

HSE Management System Closing Conference

The HSE Audit Team will review the draft report which includes:

- the site's present status as it relates to their HSE process
- recommendations identified to improve their HSE process scores (individual and overall)

Site responsibilities include:

- developing an action plan for recommendations
- submit final report and action plan to division manager and Corporate Director EHS
- Six (6) month reporting via database

HSE Management System Audit Database

- ❑ Access Database Program
- ❑ Contains all aspects of the HSE Management Systems Audit Program
  - ✓ HSE Management Systems Questions
  - ✓ Field Notes
  - ✓ Final Report
  - ✓ Recommendation Reports
  - ✓ Tracking of "open" audit findings
  - ✓ Generates charts and graphs

Name	:	Ernest W. Alexander
Signature	:	Ernest W. Alexander
Name and Title of Authorised Signatory	:	Ernest W. Alexander--Managing Director
Applicant's Company Name	:	Centech International LLC
Applicant's Company Stamp	:	Centech International LLC P.O. Box 2170, Mills, Wyoming 82644 3444 Burd Road, Casper, Wyoming 82601

SECTION SIX
Part **2**

HSEMS GUIDELINES CLARIFICATION

Documentation for communication on HSE Policy shall be provided as follows:

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

HSEMS GUIDELINES

HEALTH, SAFETY, AND ENVIRONMENTAL GUIDELINES

Centech International (CI) is committed to providing a safe, healthy workplace for its employees and those of its contractors and subcontractors. The safety and well-being of those with whom this Company works is of paramount importance to us. Job safety is considered a critical driver in our aim to achieve operational excellence and incident-free operations through safe, reliable, efficient and environmentally sound operations.

Centech International CI shall comply with the following HSE Guidelines when providing services to our customers. These guidelines are to be considered as minimum standards, These guidelines are intended to supplement, not replace, EMPLOYER'S safety program; And to ensure compliance with industry and other regulatory HSEM standards as applicable. The term Centech International (CI), as used in these guidelines, shall be understood to include any and all subcontractors performing work under terms of the contract under consideration.

1.0 Responsibility for Compliance

1.1 Centech International (CI) shall communicate these guidelines, as well as any other health, environmental and safety requirements provided by EMPLOYER, to all of its employees, subcontractors, and the employees of its subcontractors.

1.2 Centech International (CI) shall also require its subcontractors to comply with such health, environmental and safety laws, rules, regulations and standards and any other requirements specified by EMPLOYER in connection with the performance of work and shall be responsible for ensuring such compliance by its subcontractors.

1.3 Prior to the commencement of any work activity, Centech International shall provide EMPLOYER with the name and qualifications of its qualified representative(s) and those of its subcontractors who will be responsible for health, environmental and safety protection at the job site(s).

2.0 Health, Environmental and Safety Protection

2.1 Prior to the commencement of any work activity, Centech International shall submit a HSE Protection Work Plan to EMPLOYER for review. The Plan shall describe the health, environmental and safety issues and risks associated with the work, and environmental programs in place to address these issues

2.2 Centech International's HSE Protection Work Plan shall be based on, and comply with, applicable laws, decrees, administrative rules and regulations, relevant policy and operating procedures.

2.3 Prior to starting a project, Centech International's HSE representative shall participate in a safety, health, and environmental protection orientation with the EMPLOYER'S designated on-site manager.

2.4 Centech International shall not start work without a HSE Work Plan, that has been accepted in writing by Centech International and EMPLOYER.

Prior to starting any work, Centech International shall perform a Job Safety Analysis ("JSA"). The JSA shall (i) carefully study and record each step of a job, (ii) identify existing and/or potential equipment, environmental, or action-generated job hazards, and (iii) determine the best way to perform the job to reduce or eliminate hazards. Incident The JSA shall be developed and/or reviewed by and fully understood by all persons who will participate in the performance of the work. A copy of each JSA and documentation showing that the JSA has been communicated to and fully understood by all workers.

2.5 Centech International shall participate in a Behavioral Based Safety Process which shall include:

a. Identification and documentation of critical safety behaviors
b. Training personnel to observe co-workers for safe (and questionable or at-risk) performance
c. Making observations of co-workers for safe (and questionable or at-risk) performance
d. Feedback after completion of the observation
e. Collection and documentation of observation and feedback data
f. Perform trend analysis
g. Action planning
h. Follow-up on action plans

2.6 All observations, feedback, and recommended corrective actions shall be in writing. Centech International shall evaluate observations of questionable or at-risk activities in order to determine if the JSA requires modification to further mitigate risks. Centech International shall update, document, and communicate any changes in the JSA prior to performing the work.

3.0 Entrance To Property

3.1 While performing work on EMPLOYER premises, Centech International shall comply with all security requirements.

3.2 Centech International Representative, immediately after notification of award of a job will arrange for pass badges for each employee, vehicle entry permits, and instructions on how the pass system operates.

3.3 Centech International shall advise all employees as to the entrance area and/or parking facilities, if any, to be used by company, its employees, agents, and Subcontractors. Centech International shall ensure that only those persons having authorized business in connection with the performance operation are allowed on the work site.

3.4 Centech International, its employees, agents, and Subcontractors shall observe the posted speed limit, or if not posted, a safe speed in light of existing conditions and shall follow any other safe driving practices as may be applicable.

4.0 Work-site Permits

Prior approval is required for the following work activities:

a. Working on existing equipment
b. Using a torch, spark generator, electrode, melting pot, forge, electric motor, soldering iron or any open flame.
c. Closing walkways, roads or restricting traffic. (Proper warning signs shall be used .)
d. Using utilities such as compressed air, steam, water, or electricity.
e. Sandblasting, grinding, or spray painting.

f. Storing flammables, such as gasoline, oils, paints. Oxygen and presto bottles, etc.
g. Walking or working upon any roofs over buildings or equipment.
h. Working any time at variance with the regular schedule agreed upon at start of job .
i. Disposing of rubbish, scrap materials, and materials left over from job.
j. Expected material deliveries.
k. Repairing equipment on work-site property.

5.0 Pressure Testing

Centech International personnel and its subcontractors shall not test pipes or pressure vessels using compressed air or gas or service fluid, except after prior approval.

6.0 Equipment

Centech International personnel shall operate all operate equipment, valves, switches, or electric circuits in accordance with established regulatory requirements.

7.0 Hazardous Materials

7.1 Centech International, and its subcontractors shall ensure the safe and proper environmentally sound storage, transportation, identification, security safety, and handling of hazardous materials used in performance of the work while under their charge or control.

7.2 Centech International, shall maintain Material Safety Data Sheets (MSDSs) for all chemicals and other hazardous materials used in performance of the work, and shall perform all work consistent with the use specifications and other information in such MSDSs.

7.3 All chemicals and other hazardous materials used in performance of the work shall be maintained in their original containers or other containers properly labeled in accordance with OSHA HAZCOM requirements and other state or local requirements. Water supplies shall be labeled "potable" or "non-potable" as appropriate.

8.0 Ladder Safety

The following practices apply when ladders are used in the performance of work:

a. Face the ladder and have both hands free.
b. Do not overreach, and never slide down the ladder.
c. Keep soles of shoes free from excessive oil or water.
d. Do not step on any rung or step higher than the third from the top of any portable stepladder.
e. Never place a ladder in front of a door or passageway unless door is locked or guarded.
f. Never place a ladder against a windowpane.
g. Never place a ladder against a shaky structure.
h. Make sure ladder is stable and on solid footing.

9.0 Fire Protection

Centech International, and its subcontractors shall take all reasonable precautions to prevent fires. Paper, rags, trash, and other combustible materials shall be exposed of only in safe containers.
All applicable Fire & Safety regulations will be adhered to by all Centech International employees and its Subcontractors.

9.1 Flammable liquids, such as gasoline, kerosene, and fuel oil, shall be stored in industry-approved metal containers designed specifically for handling these liquids. Such flammable liquids shall be stored away from possible sources of ignition in accordance with recognized industry standards or guidelines.

9.2 Portable fuel containers r shall be placed on the ground prior to filling in order to safely dissipate any static charge that may develop during filling.

9.3 NO EMPLOYEE shall alter or tamper with fire protection equipment or render it inaccessible.

9.4 No employee or subcontractors shall open or close hydrants or main water valves except after prior notice from the appropriate representative or in the case of emergency.

9.5 Any leak or indication of gas around piping or vessels shall be immediately report to designated authority. All "hot work" in the area ceases immediately upon the discovery of a hazard.

9.6 Centech International shall ensure that all personnel receive training in fire and safety prevention, protection, medical aid, and emergency procedures.

10.0 Personal Protective Equipment & Supplies

The CONTRACTOR and its subcontractors shall provide its own first aid personnel, equipment, and supplies which shall meet requirements of local, state, and federal regulations unless otherwise agreed by the parties in writing.

10.2 Centech International and subcontractor personnel on the job site shall wear appropriate personal protective equipment, including but not limited to, fall protection, steel-toed and shanked safety shoes, hard hats, safety glasses (with side shields) and additional personal protective equipment (hearing protection, respiratory protection, face shields, hand protection) as may be required by the nature of the work and/or as specified by applicable regulations and industry standards. The required personal protective equipment shall be identified in the HSE Protection work plan and the JSA for the work to be performed. When specialized personal protective equipment is required, signs shall be posted specifying where personal protective equipment use is required.

10.3 All personal protective equipment shall be used and maintained in accordance with manufacturer recommendations.

11.0 Incident Reporting

11.1 Incident accountability shall promptly and accurately report all on-the-job incidents / injuries to the appropriate representative or proper governmental authorities where required; and shall report and document all potential hazards, unsafe conditions, and unsafe acts. All near-miss reports shall be provided to the appropriate representatives.

11.2 On-the-job incidents / injuries shall be immediately reported; and confirmed in writing within twenty-four(24) hours after the incident occurs. This includes fatalities, injuries, fires, releases of hazardous substances, motor vehicle accidents, and damages.

11.3 Centech International shall maintain and file required incident forms pursuant to procedures as required by law, decree, administrative rule or regulation, or other legally binding policy interpretation or pronouncement of a legal jurisdiction or authority.

11.4 Written summaries of all incidents affecting safety and spills shall be provided

monthly to safety representative, monthly, unless otherwise specified. A Root Cause Analysis (RCA) shall promptly be performed after the occurrence of an incident and provided to HSE representatives as applicable. RCA is required when:

a. An incident results in an OSHA recordable injury or fatality.

b. A hazardous material or petroleum release spills 1 gallon or greater on land or results in a sheen on water.

c. A discharge exceeds National Pollutant Discharge Elimination System (NPDES) guidelines or permits.

d. A fire occurs.

e. After motor vehicle accident takes place.

f. A "near miss / loss" or minor incident occurs, which, under different circumstances, would have resulted in a serious injury, reportable spill, property loss, fire, or motor vehicle crash.

g. An incident occurs frequently.

h. A significant financial incident occurs, e.g., equipment failure.

11.5 To conduct an RCA, include at least the following six steps:

a. Describe what happened, when, and where.
b. Determine the actual and potential loss or losses
c. Determine the root causes of the incident.
d. Determine the risk of recurrence.
e. Develop controls to reduce the risk of recurrence.
f. Communicate the lessons learned

12.0 Environmental Protection

12.1 Centech International shall prevent spills or releases of oil or chemical substances on land, water or air. Pollution prevention shall be a routine part of Centech's business and work activities.

12.2 Centech International shall exercise all necessary care to protect and preserve the environment, including flora, fauna and other natural resources or assets at any location where the work is performed; shall minimize and mitigate unavoidable impacts to the local environment.

12.3 CI shall assess the environmental hazards of materials and supplies used in conjunction with the work and shall use substitute materials presenting less risk whenever possible.

12.4 CI shall keep a reasonable degree of order by properly disposing of accumulated rubbish and waste materials. CI and its subcontractors shall start site cleanup and remediation immediately upon completion of work at that site.

12.5 Unless otherwise approved, Centech International shall prohibit its employees from hunting, disturbing, or capturing native birds, fish or other animals in the vicinity of the work site.

12.6 Centech International shall not remove trees and vegetation to an extent greater than is necessary for the work, as determined by established regulatory guidelines or in accordance with the applicable permit. Whenever feasible, topsoil shall be stockpile for subsequent use in site restoration.

12.7 Loading and drainage connections to fuel storage tanks shall be are either

plugged or locked in the closed position when not in use, and fuel dispensing nozzles are self-closing.

12.8 Oil, solvents, chemicals, etc. shall not be discharged to water bodies or onto land.

12.9 Centech International shall comply with all federal, state and local laws, rules, regulations, agency policies and guidance documents relating to pollution or protection of the public health and the environment including, but not limited to, the emission, discharge, release, manufacture, processing, distribution, use, treatment, handling, storage, disposal, or transportation of substances, materials, pollutants, contaminants, chemical, solid waste, and/or hazardous substances.

13.0 Miscellaneous

13.1 Centech International prohibits the use, possession, distribution, or sale of illegal drugs and controlled substances used by any person at any time. However, prescription medication that is obtained by a valid prescription and that does not impair work performance is exempted from this prohibition. This prohibition also applies to the use, possession, distribution, or sale of unauthorized alcohol, firearms, and explosives. Individuals found in violations shall be removed from premises immediately, and, if warranted individuals will be reported to the appropriate law enforcement agencies.

13.2 Compressed gas cylinders shall be secured in place on a regular cart or chained to a support in an upright position. All cylinders not in use shall be protected with protective valve caps. Compressed oxygen and flammable gases shall not be stored near combustible materials, but shall be stored in accordance with facility safety procedures and local, state, and federal regulations.

13.4 No firearms, ammunition, or deadly weapons are permitted on work site property except as may be authorized by appropriate authorities for security purposes to ensure adequate protection of property.

13.5 Centech International shall ensure that their personnel abide by existing state, federal, and local occupational health, safety, and environmental regulations.

SECTION SIX

PART 3

HSE RESOURCES CLARIFICATION

Centech International LLC

P.O. Box 2170, Mills, Wyoming 82644
3444 Burd Road, Casper, Wyoming 82601

RESOURCES

I. Centech International HSE Team

a. Oil Field Remediation Services/Technology	Neal Miller/Quinton Miller
b. Chemical Engineering	Ph.D. William J. Parkinson
c. Chemical Engineering / Software & Tools	Ph.D. Ronald E. Smith
d. Environmental Services Consultant	Meldan Environmental Services
e. Environmental Services Consultant	Taylor Environmental Consulting, LLC
f. Laboratory Analysis Services Consultant	Deborah Munn
g. HSE Safety Officer	

II. Centech International HSE Regulatory Resources

a. EPA Guidelines
b. Occupational Safety & Health Administration (OSHA)
c. American Petroleum Institute
d. AOAC Test Methods ["Association of Analytical Communities," AOAC INTERNATIONAL]
e. ASTM Test Methods [Formerly known as the American Society for Testing and Materials, ASTM International]
f. ISO [International Organization for Standardization]
g. EPA Test List [U. S. Environmental Protection Agency]
h. DIN Standardization Methods [Deutsches Institut für Normung]
i. Standard Methods for the Examination of Water and Wastewater
j. CFR Test Methods, U.S. [The Code of Federal Regulations]
k. I P Test Method [The Institute of Petroleum]
l. World Health Organization [World Health Organization]
m. UOP™ Test Methods [Universal Oil Products]
n. Other (KOC-HSEM Guidelines, KOC-Fire & Safety Regulations)

.

SECTION SIX

PART 5

HAZARD/RISK ANALYSIS

The following section cites Risk control measures & Risk categorization for Hazard/Risk Analysis

HAZARD ANALYSIS

a. Waste Analysis

(1) Waste analysis may be performed by the generator of the waste, the treatment facility, independent laboratory, or any combination of these. Depending on the waste type concern, the objectives for testing wastes may include:

- ▶ Verifying that the waste is an Energy & Production (E&P) waste and is approved for disposal at the facility;
- ▶ Verifying that a non-exempt waste is non-hazardous (testing for hazardous characteristics);
- ▶ Identifying potential community issues, such as odor or visible emissions; and
- ▶ Identifying potential safety or environmental hazards to site employees or surrounding area.

(2) As specific testing criteria are established by federal, local, and industry regulations, or by permit conditions; consideration to limit the potential of future liability through prudent testing is often employed. For many established customers, knowledge of the process or source of the wastes, or an initial waste profile, may be all that is necessary. Centech employs the following spot-check standard to it customers or for new waste streams:

- ▶ Visual observations;
- ▶ pH checks;
- ▶ Conductivity or chloride testing;
- ▶ Testing of the vapors for flammability or hydrocarbon content; and
- ▶ Testing of vapors or liquid for reactive sulfides.

There are a variety of published data sources that may provide an indication of the constituents of various E&P waste streams. While these cannot substitute for knowledge of the specific waste being treated, they may assist facilities in determining the types of wastes to be accepted/or treated and which waste streams, if any, may be appropriate for testing.

b. Sampling and Analysis

(1) Existing workplans. Sampling and analysis for sites subject to an approved workplan shall be conducted in accordance with the workplan and the sampling and analysis requirements described in this rule.

(2) Methods for sampling and analysis. Sampling and analysis for site investigation or confirmation of successful remediation shall be conducted to determine the nature and extent of impact and confirm compliance with appropriate allowable concentrations.

c. Field Analysis

Field measurements and field tests shall be conducted using appropriate equipment, calibrated and operated according to manufacturer specifications, by personnel trained and familiar with the equipment.

d. Sample collection

Samples shall be collected, preserved, documented, and shipped using standard environmental sampling procedures in a manner to ensure accurate representation of site conditions.

e. Laboratory Analytical Methods

Laboratories shall analyze samples using standard methods (such as EPA SW-846 or API RP-45) appropriate for detecting the target analyte. The method selected shall have detection limits less than or equal to the allowable concentrations.

f. Background Sampling

Samples of comparable, nearby, non-impacted, native soil, ground water or other medium may be required by the Director for establishing background conditions.

g. Soil sampling and analysis

(1) Applicability. If soil contamination is suspected or known to exist as a result of spills/releases or E&P waste management, representative samples of soil shall be collected and analyzed in accordance with this rule.

(2) Sample collection. Samples shall be collected from areas most likely to have been impacted, and the horizontal and vertical extent of contamination shall be determined. The number and location of samples shall be appropriate to the impact.

(3) Sample analysis. Soil samples shall be analyzed for contaminants listed as appropriate to assess the impact or confirm remediation.

(4) Reporting. Soil Analysis Report Form, shall be used for documentation results of soil analyses.

(5) Soil impacted by produced water. For impacts to soil due to produced water, samples from comparable, nearby non-impacted, native soil shall be collected and analyzed for purposes of establishing background soil conditions including pH and electrical conductivity (EC). Where EC of the impacted soil exceeds the allowable level the sodium adsorption ratio (SAR) shall also be determined.

(6) Soil impacted by hydrocarbons. For impacts to soil due to hydrocarbons, samples shall be analyzed for TPH.

h. Ground water sampling and analysis.

(1) Applicability. Centech personnel shall collect representative samples of ground water & expedite analysis in accordance with these rules under the following circumstances:

i. Where ground water contamination is suspected or known to exceed the allowable concentrations

ii. Where impacted soils are in contact with ground water; or

iii. Where impacts to soils extend down to the high water table.

(2) Sample collection. Samples shall be collected from areas most likely to have been impacted, down gradient or in the middle of excavated areas. The number and location of samples shall be appropriate to determine the horizontal and vertical extent of the impact. If the allowable concentrations are exceeded, the direction of flow and a ground water gradient shall be established, unless the extent of the contamination and migration can otherwise be adequately determined.

(3) Sample analysis. Ground water samples shall be analyzed for benzene, toluene, ethylbenzene, xylene, and API RP-45 constituents, or other parameters appropriate for evaluating the impact.

(4) Reporting. Water Analysis Report Form shall be used for documentation results of water analyses.

(5) Impacted ground water. Where ground water contaminants exceed the allowable concentrations, Centech shall notify the Designated Representative and submit to the same prior approval a Site Investigation and Remediation Workplan Form, for the investigation, remediation, or monitoring of ground water to meet the required allowable concentrations.

i. Cross-media impacts

The overall goal of waste treatment is to reduce the volume or the toxicity of waste that has been accumulated or delivered to a facility so that the waste can be disposed without harm to human health or the environment. In treating a waste stream, Centech will assure that the potentially harmful components are not inadvertently being transferred from one media to another. Our selection of the three-phase centrifuge treatment method for waste type and volume in conjunction with a pre-approved plan ultimate disposal method ensures effective quality control for these factors allowing for safer and more effective waste management, resulting in decreased exposure of waste components to human health and the environment.

j. Secondary disposal

Some waste treatment processes result in residual material. This residual, post-treatment waste should be disposed of in ways that minimize any adverse impacts to human health and the environment. Re-use or recycling of residual material is desirable where feasible, as regulatory guidelines specify constituent levels that must be met for residual material to be re-used. Potential re-uses of residual material include landfill cover and fill dirt for road building or other construction activity. Centech will keep records of the volume of residual material moved off-site, any analyses of the residual material, its intended use, and ultimate location.

Health and Safety Risk Analysis

1.0 Health and Safety Risk Analysis (Health, Safety, & Environmental)

All persons working on the site will observe all applicable rules and regulations established by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and other applicable regulatory guidelines.

Work at the site is associated with a variety of hazards, both physical and chemical. The purpose of this plan is to reduce the risks of working on the site. The preferred method is to eliminate the hazard, whenever practicable; the second choice is to use engineering controls; the Last choice is to use personal protective equipment. The general hazards to be encountered on the site, and the procedures to reduce these hazards, are presented below.
The first task at the site shall be to gather miscellaneous debris scattered throughout the Work and Treatment Zones and store it in the Staging Area. Existing scaffolds and elevated walkways will be evaluated. Those items unnecessary to site operation and posing a potential hazard will be dismantled. Those items necessary to operation will be examined and repaired, as needed. Thereafter, the Project Site Manager will make weekly examinations of the structures and ensure proper maintenance. Potential site hazards have been grouped into four categories: heavy equipment, fire, other physical hazards, and chemical hazards

1.2 Heavy Equipment

Some of the most hazardous situations that may occur are associated with heavy equipment operation. The following requirements are intended to alleviate these hazards.

- ▶ Operators must be qualified on equipment; documentation will be required.
- ▶ Heavy equipment must be kept at least 15 feet away from poles that support overhead power lines.
- ▶ Back-up alarms are required.
- ▶ Personnel must make eye contact with the operator before approaching the equipment.
- ▶ Operators must wear seat belts when they are available.

1.3 Fire/Explosion Hazards

Onsite personnel may be exposed to fire/explosion hazards at any time. These hazards include:

- ▶ Excavating into underground tanks containing liquid petroleum hydrocarbons or fumes;
- ▶ Excavating into underground pipelines carrying liquid petroleum hydrocarbons or fumes;

- ▶ Dismantling and removing above-ground storage tanks containing liquid petroleum hydrocarbons or fumes;
- ▶ Generation of hydrocarbon vapor clouds during tank-emptying activities;
- ▶ Sparking of combustible petroleum hydrocarbons in the air, in soil gas, on soils; and
- ▶ Equipment fires.

1.3.1 Ignition Sources

Because of the flammable nature of hydrocarbons, ignition sources other than the treatment units will be kept out of the Work Zone and Treatment Zone:

▶ No matches or cigarette lighters are allowed in the Work or Treatment Zones. A hot-work permit will be required for open-flame work.

▶ Internal combustion engines must not be operated in the Work Zone while hydrocarbon-contaminated solids or liquids might be brought to the surface; alternatively, they must be equipped with spark arresters.

▶ Intrinsically safe hand, electrical, and mechanical (non-sparking wrenches, etc.) shall be used when working on drums and while working in the Work Zone.

▶ Explosion-proof instruments and system-wide electrical grounding will be used to prevent fires.

1.3.2 Fire Precautions

Subcontractors on the site shall comply with all requirements of this document and of the Uniform Fire Codes, and KOC-Fire & Safety Regulations in providing temporary storage of materials used in their treatment processes. All vehicles in the Work and Treatment Zones must be equipped with an appropriate fire extinguisher.

The following additional precautions will be observed to minimize the potential for fire or explosion:

▶ Excavation will proceed slowly for the first five feet to minimize damage to underground lines.

▶ Combustible gas measurements will be taken regularly during the excavation of a tank and during tank entry.

▶ Tanks shall be vented or purged before fluids are removed; if Ere, smoke, or heat emanates from any tank or excavation, personnel will evacuate the vicinity immediately; work will not resume until the signs of fire or explosion have disappeared.

▶ If total organic vapors exceed 10% of the lower explosive limit (LEL) in the Work Zone, personnel will stop work and move upwind. Measures (such as a nitrogen gas purge) will be taken to subdue combustible vapor emissions.

1.3.3 Fire-Fighting Equipment

Fire extinguishers (type BC or equivalent) and fire blankets will be located on posts throughout the Work Zone. However, *fire extinguishers are to be used only in the incipient stages of a fire*. Fire extinguishers shall be inspected periodically and maintained in operating condition.

1.3.4 No Smoking Area

No smoking is permitted within the site perimeter fence.

1.4. Other Physical Hazards

Feasible engineering controls shall be utilized to protect employees against excessive noise, in accordance with 29 CFR 1910.95 (*see Table 1-1*). The noise will be monitored throughout the site. Noise levels that exceed an 8-hour time-weighted average of 85 decibels require a haring conservation program.

TABLE 1-1 PERMISSIBLE NOISE EXPOSURES	
Duration per Day-Hours	**Sound Level in Decibels**
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or less	115

1.5 Buildup of Explosive Gases
The presence of combustible/explosive gases will be monitored whenever the potential exists for their accumulation. Further action will be taken if the level exceeds 10% of the Lower Exposure Limit (LEL). The OSHA limits of employee exposure to chemicals; found primarily in 29 CFR 1910.1000, Table Z-1.

1.6. Splashes
Shower and eye wash facilities will be available in the office trailer in the event of an emergency. If the MSDS for any chemical brought onsite calls for an eyewash, an eyewash station shall be established in the immediate vicinity of that chemical's use.

1.7 Pits
The pits will be covered with netting most of the time. Work at the pits will be performed remotely whenever practical. Caution must be exercised near the pit edges. A lifeline will be available at the pit when work is in progress there.

1.8 Propane Tanks
Propane tanks shall comply with OSHA 29 CFR 1910.106 and with appropriate fire codes.

1.9 Fugitive Dust
A potential hazard on the site will be nuisance dust, especially in the warm months during windy conditions. Monitoring of airborne particulates will be performed on the site and evaluated for associated health risks. If the airborne particulate level approaches permissible exposure limits, dust-control measures will be implemented. The use of respirators will be required if the situation presents a health hazard. See Section 2.3 Heavy Metals.

2.0 Chemical Hazards
Potentially hazardous chemicals that have been detected on the site include those shown in *Table 1-2*. The maximum concentration found on the site and the location of that concentration are given. Also shown are the *recommended exposure limits* (REL.) determined by the National Institute for Occupational Safety and Health (NIOSH) and the OSHA time- weighted average *permissible exposure limits* (PEL).

2.1 Chemicals
Any chemicals brought to the site must be accompanied by *material safety data sheets (MSDSs)*, to be located in a centralized area and made available to all site personnel.
Protective equipment, including eyewash stations, shall be provided as specified in the MSDSs. Each subcontractor is responsible for providing hazard communication training to its employees regarding these chemicals.

2.2 Petroleum Products on Site
The chemical products on the site consist primarily of petroleum products. Material data safety sheets (MSDSs) will be provided for all identified products located on the site.

Evaluations indicate that the most likely chemical hazard is benzene. Because analytical data may reveal the presence of sulfur and because hydrogen sulfide is a common hazard associated with crude oil, hydrogen sulfide will also be monitored. Direct reading tubes will be used to monitor for these substances.

2.3 Heavy Metals On Site

An evaluation will be performed to identify if any of the metals cited in *Table 2-1* might pose a health hazard to personnel on site. Arsenic, for example, is found in the soil and could be inhaled on particulates during dry, windy days. However, before the arsenic in the dust would exceed its permissible exposure limit, the nuisance dust itself would have far exceeded both the permissible exposure limit and tolerable levels. In other words, dust and not arsenic-laden dust—is the primary concern. If sources of contamination at higher concentrations are identified on the site, this conclusion could change. Centech is cognizant of potential exposure pathways and will be alert to new information.

TABLE 2-1 CONCENTRATION LIMITS FOR SELECTED CHEMICALS WHICH MAY BE FOUND ON SITE

Chemical	Media	NIOSH REL	OSHA PEL
Benzene	fluid	0.1 ppm	1 ppm
Toluene	fluid	100 ppm	100 ppm
Ethylbenzene	fluid	100 ppm	100 ppm
Xylene	fluid	100 ppm	100 ppm
Arsenic	soil	0.002 mg/m^3	0.01 mg/m^3
Barium	fluid	0.5 mg/m^3	0.5 mg/m^3
Chromium	fluid	0.5 mg/m^3	0.5 mg/m^3
Lead	fluid	0.1 mg/m^3	0.5 mg/m^3
Cadmium	soil	minimize	0.2 mg/m^3
Nickel	fluid	0.15 mg/m^3	0.1/m^3
Vanadium	fluid	0.05 mg/m^3	0.05 mg/m^3
Silver	fluid	0.1 mg/m^3	0.1 mg/m^3
Sulfur	fluid	10 ppm H_2S	10 ppm H_2S

REL = recommended inhalation exposure limit
REL = permissible inhalation exposure limit

3.0 Personal Protective Equipment

Level C and D protection shall be available for use on the site.

Level D protection is the minimum protection required in the Work and Treatment Zones. Level D will be satisfactory when:

- the atmosphere contains no know hazard
- the work functions contain no risk of splashing, immersion, inhalation, or contact with hazardous chemicals, and
- atmospheric concentrations are below one-half the threshold limit value for contaminants

Level D protection will consist of the following items; all of which meet applicable standards set by the American National Standards Institute (ANSI).

- sturdy work shoes or ANSI approved safety-toed shoes/boots
- hard hat
- safety glasses

Level C adds the use of respiratory protection, all certified by the National Institute for Occupational Safety and Health (NIOSH):

- full-face or half-face, air purifying respirator
- combination organic vapor/HEPA filter cartridge

Respirator protection will be required when the photoionization detector (PID) reading in ambient air exceeds 100 ppm TOV or when the dust monitor or indicator tubes reveal exposure levels exceeding permissible exposure limits. An indicator tube will be used to measure benzene concentration whenever the PID level exceeds 5 ppm above background.

4.0 Air Monitoring Program

Air monitoring will be performed in accordance with OSHA 29 CFR 1910.120(h) to evaluate air quality in order to:

- determine the appropriate protection required for site workers,
- identify areas where protection is needed,
- assess the potential health effects of exposure, and
- determine the need for specific medical monitoring
- air monitoring will also be used to establish background or baseline levels

4.1 Air-Monitoring Equipment

The equipment shown in *Table 4-1* will used. The table summarizes the intended use of each instrument, action levels, frequency of calibration, and equipment limitations.

4.2 Calibration Specifications

The equipment will be calibrated using the specifications shown in *Table 4-2.*

4.3 Personal Monitoring

To confirm that individual worker exposure is below permissible limits in Level D protection, Centech will administer a personal monitoring program. This monitoring will occur at least annually. During work operations, the person deemed to have the highest exposure to organic vapors will be equipped with personal monitoring devices to measure such chemicals as benzene, toluene, xylene, and ethylbenzene. If the monitoring reveals no dangerous exposure, then all persons performing similar work will be assumed to be safe in Level D protection.

Personal dust monitoring will be done for a person working in the most dusty area. Exposure to arsenic, lead, cadmium, and chromium will be measured to confirm that Level D protective measures are adequate.

TABLE 4-1 AIR MONITORING EQUIPMENT SPECIFICATION

Instrument	Use	Action Levels		Frequency	Calibration	Limitations
Barcharach Sniffer 302 Combustible gas indicator 0_2 meter	Detection of explosive/ flammable atmosphere	<10% LEL 10-20% LEL >20% LEL	Continue work Move upwind; vent or purge Explosion hazard; stop work; leave area	As needed	Daily & after any reading >100 LEL	Invalid <-4° F; Tetraethyl lead, sulfur, & silicone poison sensor
	Measurement of % 0_2 in air	>25.0% 0_2 20.9% 0_2 <19.5% 0_2	Explosion hazard; evacuate or purge Normal 0_2 0_2 deficient; vent or use SCBA	As needed	Daily	
Determinator Photoionization Detector (PID)	Measurement of total organic and some inorganic gases & vapors	≥5 ppm <100 ppm ≥100 ppm	Check for benzene Level D protection Level C protection	As needed	Daily	Cannot sense methane; IP of chemical must be < lamp energy; dirt & humidity foul the lamp
Direct Reading Tubes	Measurement of benzene	<1 ppm 1-9 ppm ≥10 ppm	Level D protection Level C protection Stop work; evacuate situation	When PID >5 ppm or at start of new activities that could emit benzene	N/A	
	Hydrogen sulfide	≥10 ppm	Stop work; evacuate situation	As needed		
Dust Monitor: Mini-Ram	Measurement of airborne particulates	≥5 mg/m^3 ≥15 mg/m^3	Apply dust controls put on respirators or stop work	As needed	Zero daily	
Noise Level Monitor	Measurement of noise levels	≥90 decibels	Use hearing protection	As needed	To be determined	

TABLE 4-2 CALIBRATION SPECIFICATION

Instrument	Gas	Reading
Determinator PID, 10.2 eV Lamp	100 ppm isobutylene in air	100 ± ppm
Bacharach Sniffer 301 CGI	2.5% methane in air	50% LEL ± 5% LEL
+ 0_2 meter	Normal ambient air	20.9%
Century OVA-88	Double internal calibration points	100 ppm 100,000 ppm

SECTION SIX
PART 6
HSE PROGRAMS & PROCEDURES

PROCEDURES

Centech International has learned valuable lessons throughout its performance history that have enhanced our ability to satisfy regulatory compliances as we integrate comprehensive procedural checks and balances, and applicable regulatory standards into each functional area of operations as referenced in the following documentation of Centech's Pre-Qualification submittal. **SEE PREVIOUS ATTACHMENTS: Section Six-Attachments 2, 4, 5 and Section Three-Continuations.**

1.0 Responsibility for Compliance

1.1 Centech International (CI) shall communicate these guidelines, as well as any other health, environmental and safety requirements provided by EMPLOYER, to all of its employees, subcontractors, and the employees of its subcontractors.

1.2 Centech International (CI) shall also require its subcontractors to comply with such health, environmental and safety laws, rules, regulations and standards and any other requirements specified by EMPLOYER in connection with the performance of work and shall be responsible for ensuring such compliance by its subcontractors.

1.3 Prior to the commencement of any work activity, Centech International shall provide EMPLOYER with the name and qualifications of its qualified representative(s) and those of its subcontractors who will be responsible for health, environmental and safety protection at the job site(s).

2.0 Health, Environmental and Safety Protection

2.1 Prior to the commencement of any work activity, Centech International shall submit a HSE Protection Work Plan to EMPLOYER for review. The Plan shall describe the health, environmental and safety issues and risks associated with the work, and environmental programs in place to address these issues

2.2 Centech International's HSE Protection Work Plan shall be based on, and comply with, applicable laws, decrees, administrative rules and regulations, relevant policy and operating procedures.

2.3 Prior to starting a project, Centech International's HSE representative shall participate in a safety, health, and environmental protection orientation with the EMPLOYER'S designated on-site manager.

2.4 Centech International shall not start work without a HSE Work Plan, that has been accepted in writing by Centech International and EMPLOYER.

Prior to starting any work, Centech International shall perform a Job Safety Analysis ("JSA"). The JSA shall (i) carefully study and record each step of a job, (ii) identify existing and/or potential equipment, environmental, or action-generated job hazards, and (iii) determine the best way to perform the job to reduce or eliminate hazards. Incident The JSA shall be developed and/or reviewed by and fully understood by all persons who will participate in the

performance of the work. A copy of each JSA and documentation showing that the JSA has been communicated to and fully understood by all workers.

2.5 Centech International shall participate in a Behavioral Based Safety Process which shall include:

a. Identification and documentation of critical safety behaviors
b. Training personnel to observe co-workers for safe (and questionable or at-risk) performance
c. Making observations of co-workers for safe (and questionable or at-risk) performance
d. Feedback after completion of the observation
e. Collection and documentation of observation and feedback data
f. Perform trend analysis
g. Action planning
h. Follow-up on action plans

2.6 All observations, feedback, and recommended corrective actions shall be in writing. Centech International shall evaluate observations of questionable or at-risk activities in order to determine if the JSA requires modification to further mitigate risks. Centech International shall update, document, and communicate any changes in the JSA prior to performing the work.

3.0 Entrance To Property

3.1 While performing work on EMPLOYER premises, Centech International shall comply with all security requirements.

3.2 Centech International Representative, immediately after notification of award of a job will arrange for pass badges for each employee, vehicle entry permits, and instructions on how the pass system operates.

3.3 Centech International shall advise all employees as to the entrance area and/or parking facilities, if any, to be used by company, its employees, agents, and Subcontractors. Centech International shall ensure that only those persons having authorized business in connection with the performance operation are allowed on the work site.

3.4 Centech International, its employees, agents, and Subcontractors shall observe the posted speed limit, or if not posted, a safe speed in light of existing conditions and shall follow any other safe driving practices as may be applicable.

4.0 Work-site Permits

Prior approval is required for the following work activities:

a. Working on existing equipment
b. Using a torch, spark generator, electrode, melting pot, forge, electric motor, soldering iron or any open flame.
c. Closing walkways, roads or restricting traffic. (Proper warning signs shall be used .)
d. Using utilities such as compressed air, steam, water, or electricity.
e. Sandblasting, grinding, or spray painting.
f. Storing flammables, such as gasoline, oils, paints. Oxygen and presto bottles, etc.
g. Walking or working upon any roofs over buildings or equipment.
h. Working any time at variance with the regular schedule agreed upon at start of job .
i. Disposing of rubbish, scrap materials, and materials left over from job.
j. Expected material deliveries.
k. Repairing equipment on work-site property.

5.0 Pressure Testing

Centech International personnel and its subcontractors shall not test pipes or pressure vessels using compressed air or gas or service fluid, except after prior approval.

6.0 Equipment

Centech International personnel shall operate all operate equipment, valves, switches, or electric circuits in accordance with established regulatory requirements.

7.0 Hazardous Materials

7.1 Centech International, and its subcontractors shall ensure the safe and proper environmentally sound storage, transportation, identification, security safety, and handling of hazardous materials used in performance of the work while under their charge or control.

7.2 Centech International, shall maintain Material Safety Data Sheets (MSDSs) for all chemicals and other hazardous materials used in performance of the work, and shall perform all work consistent with the use specifications and other information in such MSDSs.

7.3 All chemicals and other hazardous materials used in performance of the work shall be maintained in their original containers or other containers properly labeled in accordance with OSHA HAZCOM requirements and other state or local requirements. Water supplies shall be labeled "potable" or "non-potable" as appropriate.

8.0 Ladder Safety

The following practices apply when ladders are used in the performance of work:

a. Face the ladder and have both hands free.
b. Do not overreach, and never slide down the ladder.
c. Keep soles of shoes free from excessive oil or water.
d. Do not step on any rung or step higher than the third from the top of any portable stepladder.
e. Never place a ladder in front of a door or passageway unless door is locked or guarded.
f. Never place a ladder against a windowpane.
g. Never place a ladder against a shaky structure.
h. Make sure ladder is stable and on solid footing.

9.0 Fire Protection

Centech International, and its subcontractors shall take all reasonable precautions to prevent fires. Paper, rags, trash, and other combustible materials shall be exposed of only in safe containers.
All applicable Fire & Safety regulations will be adhered to by all Centech International employees and its Subcontractors.

9.1 Flammable liquids, such as gasoline, kerosene, and fuel oil, shall be stored in industry-approved metal containers designed specifically for handling these liquids. Such flammable liquids shall be stored away from possible sources of ignition in accordance with recognized industry standards or guidelines.

9.2 Portable fuel containers r shall be placed on the ground prior to filling in order to safely dissipate any static charge that may develop during filling.

9.3 NO EMPLOYEE shall alter or tamper with fire protection equipment or render it inaccessible.

9.4 No employee or subcontractors shall open or close hydrants or main water valves except after prior notice from the appropriate representative or in the case of emergency.

9.5 Any leak or indication of gas around piping or vessels shall be immediately report to designated authority. All "hot work" in the area ceases immediately upon the discovery of a hazard.

9.6 Centech International shall ensure that all personnel receive training in fire and safety prevention, protection, medical aid, and emergency procedures.

10.0 Personal Protective Equipment & Supplies

The CONTRACTOR and its subcontractors shall provide its own first aid personnel, equipment, and supplies which shall meet requirements of local, state, and federal regulations unless otherwise agreed by the parties in writing.

10.2 Centech International and subcontractor personnel on the job site shall wear appropriate personal protective equipment, including but not limited to, fall protection, steel-toed and shanked safety shoes, hard hats, safety glasses (with side shields) and additional personal protective equipment (hearing protection, respiratory protection, face shields, hand protection) as may be required by the nature of the work and/or as specified by applicable regulations and industry standards. The required personal protective equipment shall be identified in the HSE Protection work plan and the JSA for the work to be performed. When specialized personal protective equipment is required, signs shall be posted specifying where personal protective equipment use is required.

10.3 All personal protective equipment shall be used and maintained in accordance with manufacturer recommendations.

11.0 Incident Reporting

11.1 Incident accountability shall promptly and accurately report all on-the-job incidents / injuries to the appropriate representative or proper governmental authorities where required; and shall report and document all potential hazards, unsafe conditions, and unsafe acts. All near-miss reports shall be provided to the appropriate representatives.

11.2 On-the-job incidents / injuries shall be immediately reported; and confirmed in writing within twenty-four(24) hours after the incident occurs. This includes fatalities, injuries, fires, releases of hazardous substances, motor vehicle accidents, and damages.

11.3 Centech International shall maintain and file required incident forms pursuant to procedures as required by law, decree, administrative rule or regulation, or other legally binding policy interpretation or pronouncement of a legal jurisdiction or authority.

11.4 Written summaries of all incidents affecting safety and spills shall be provided monthly to safety representative, monthly, unless otherwise specified. A Root Cause Analysis (RCA) shall promptly be performed after the occurrence of an incident and provided to HSE representatives as applicable. RCA is required when:

a. An incident results in an OSHA recordable injury or fatality.

b. A hazardous material or petroleum release spills 1 gallon or greater on land or results in a sheen on water.

c. A discharge exceeds National Pollutant Discharge Elimination System (NPDES) guidelines or permits.

d. A fire occurs.

e. After motor vehicle accident takes place.

f. A "near miss / loss" or minor incident occurs, which, under different circumstances, would have resulted in a serious injury, reportable spill, property loss, fire, or motor vehicle crash.

g. An incident occurs frequently.

h. A significant financial incident occurs, e.g., equipment failure.

11.5 To conduct an RCA, include at least the following six steps:

a. Describe what happened, when, and where.
b. Determine the actual and potential loss or losses
c. Determine the root causes of the incident.
d. Determine the risk of recurrence.
e. Develop controls to reduce the risk of recurrence.
f. Communicate the lessons learned

12.0 Environmental Protection

12.1 Centech International shall prevent spills or releases of oil or chemical substances on land, water or air. Pollution prevention shall be a routine part of Centech's business and work activities.

12.2 Centech International shall exercise all necessary care to protect and preserve the environment, including flora, fauna and other natural resources or assets at any location where the work is performed; shall minimize and mitigate unavoidable impacts to the local environment.

12.3 CI shall assess the environmental hazards of materials and supplies used in conjunction with the work and shall use substitute materials presenting less risk whenever possible.

12.4 CI shall keep a reasonable degree of order by properly disposing of accumulated rubbish and waste materials. CI and its subcontractors shall start site cleanup and remediation immediately upon completion of work at that site.

12.5 Unless otherwise approved, Centech International shall prohibit its employees from hunting, disturbing, or capturing native birds, fish or other animals in the vicinity of the work site.

12.6 Centech International shall not remove trees and vegetation to an extent greater than is necessary for the work, as determined by established regulatory guidelines or in accordance with the applicable permit. Whenever feasible, topsoil shall be stockpile for subsequent use in site restoration.

12.7 Loading and drainage connections to fuel storage tanks shall be are either plugged or locked in the closed position when not in use, and fuel dispensing nozzles are self-closing.

12.8 Oil, solvents, chemicals, etc. shall not be discharged to water bodies or onto land.

12.9 Centech International shall comply with all federal, state and local laws, rules, regulations, agency policies and guidance documents relating to pollution or protection of the public health and the environment including, but not limited

to, the emission, discharge, release, manufacture, processing, distribution, use, treatment, handling, storage, disposal, or transportation of substances, materials, pollutants, contaminants, chemical, solid waste, and/or hazardous substances.

13.0 Miscellaneous

13.1 Centech International prohibits the use, possession, distribution, or sale of illegal drugs and controlled substances used by any person at any time. However, prescription medication that is obtained by a valid prescription and that does not impair work performance is exempted from this prohibition. This prohibition also applies to the use, possession, distribution, or sale of unauthorized alcohol, firearms, and explosives. Individuals found in violations shall be removed from premises immediately, and, if warranted individuals will be reported to the appropriate law enforcement agencies.

13.2 Compressed gas cylinders shall be secured in place on a regular cart or chained to a support in an upright position. All cylinders not in use shall be protected with protective valve caps. Compressed oxygen and flammable gases shall not be stored near combustible materials, but shall be stored in accordance with facility safety procedures and local, state, and federal regulations.

13.4 No firearms, ammunition, or deadly weapons are permitted on work site property except as may be authorized by appropriate authorities for security purposes to ensure adequate protection of property.

13.5 Centech International shall ensure that their personnel abide by existing state, federal, and local occupational health, safety, and environmental regulations.

14.0. Waste Analysis

a. (1) Waste analysis may be performed by the generator of the waste, the treatment facility, independent laboratory, or any combination of these. Depending on the waste type concern, the objectives for testing wastes may include:

▶ Verifying that the waste is an Energy & Production (E&P) waste and is approved for disposal at the facility;
▶ Verifying that a non-exempt waste is non-hazardous (testing for hazardous characteristics);
▶ Identifying potential community issues, such as odor or visible emissions; and
▶ Identifying potential safety or environmental hazards to site employees or surrounding area.

(2) As specific testing criteria are established by federal, local, and industry regulations, or by permit conditions; consideration to limit the potential of future liability through prudent testing is often employed. For many established customers, knowledge of the process or source of the wastes, or an initial waste profile, may be all that is necessary. Centech employs the following spot-check standard to it customers or for new waste streams:

▶ Visual observations;
▶ pH checks;
▶ Conductivity or chloride testing;
▶ Testing of the vapors for flammability or hydrocarbon content; and
▶ Testing of vapors or liquid for reactive sulfides.

There are a variety of published data sources that may provide an indication of the constituents of various E&P waste streams. While these cannot substitute for knowledge of the specific waste being treated, they may assist facilities in determining the types of wastes to be accepted/or treated and which waste streams, if any, may be appropriate for testing.

b. Sampling and analysis.

(1) Existing workplans. Sampling and analysis for sites subject to an approved workplan shall be conducted in accordance with the workplan and the sampling and analysis requirements described in this rule.

(2) Methods for sampling and analysis. Sampling and analysis for site investigation or confirmation of successful remediation shall be conducted to determine the nature and extent of impact and confirm compliance with appropriate allowable concentrations.

c. Field analysis. Field measurements and field tests shall be conducted using appropriate equipment, calibrated and operated according to manufacturer specifications, by personnel trained and familiar with the equipment.

d. Sample collection. Samples shall be collected, preserved, documented, and shipped using standard environmental sampling procedures in a manner to ensure accurate representation of site conditions.

e. Laboratory analytical methods. Laboratories shall analyze samples using standard methods (such as EPA SW-846 or API RP-45) appropriate for detecting the target analyte. The method selected shall have detection limits less than or equal to the allowable concentrations.

f. Background sampling. Samples of comparable, nearby, non-impacted, native soil, ground water or other medium may be required by the Director for establishing background conditions.

g. Soil sampling and analysis.

(1) Applicability. If soil contamination is suspected or known to exist as a result of spills/releases or E&P waste management, representative samples of soil shall be collected and analyzed in accordance with this rule.

(2) Sample collection. Samples shall be collected from areas most likely to have been impacted, and the horizontal and vertical extent of contamination shall be determined. The number and location of samples shall be appropriate to the impact.

(3) Sample analysis. Soil samples shall be analyzed for contaminants listed as appropriate to assess the impact or confirm remediation.

(4) Reporting. Soil Analysis Report Form, shall be used for documentation results of soil analyses.

(5) Soil impacted by produced water. For impacts to soil due to produced water, samples from comparable, nearby non-impacted, native soil shall be collected and analyzed for purposes of establishing background soil conditions including pH and electrical conductivity (EC). Where EC of the impacted soil exceeds the allowable level the sodium adsorption ratio (SAR) shall also be determined.

(6) Soil impacted by hydrocarbons. For impacts to soil due to hydrocarbons, samples shall be analyzed for TPH.

h. Ground water sampling and analysis.

(1) Applicability. Centech personnel shall collect representative samples of ground water & expedite analysis in accordance with these rules under the following circumstances:

i. Where ground water contamination is suspected or known to exceed the allowable concentrations

ii. Where impacted soils are in contact with ground water; or
iii. Where impacts to soils extend down to the high water table.

(2) Sample collection. Samples shall be collected from areas most likely to have been impacted, down gradient or in the middle of excavated areas. The number and location of samples shall be appropriate to determine the horizontal and vertical extent of the impact. If the allowable concentrations are exceeded, the direction of flow and a ground water gradient shall be established, unless the extent of the contamination and migration can otherwise be adequately determined.

(3) Sample analysis. Ground water samples shall be analyzed for benzene, toluene, ethylbenzene, xylene, and API RP-45 constituents, or other parameters appropriate for evaluating the impact.

(4) Reporting. Water Analysis Report Form shall be used for documentation results of water analyses.

(5) Impacted ground water. Where ground water contaminants exceed the allowable concentrations, Centech shall notify the Designated Representative and submit to the same prior approval a Site Investigation and Remediation Workplan Form, for the investigation, remediation, or monitoring of ground water to meet the required allowable concentrations.

i. Cross-media impacts

The overall goal of waste treatment is to reduce the volume or the toxicity of waste that has been accumulated or delivered to a facility so that the waste can be disposed without harm to human health or the environment. In treating a waste stream, Centech will assure that the potentially harmful components are not inadvertently being transferred from one media to another. Our selection of the three-phase centrifuge treatment method for waste type and volume in conjunction with a pre-approved plan ultimate disposal method ensures effective quality control for these factors allowing for safer and more effective waste management, resulting in decreased exposure of waste components to human health and the environment.

j. Secondary disposal

Some waste treatment processes result in residual material. This residual, post-treatment waste should be disposed of in ways that minimize any adverse impacts to human health and the environment. Re-use or recycling of residual material is desirable where feasible, as regulatory guidelines specify constituent levels that must be met for residual material to be re-used. Potential re-uses of residual material include landfill cover and fill dirt for road building or other construction activity. Centech will keep records of the volume of residual material moved off-site, any analyses of the residual material, its intended use, and ultimate location.

1.0 Health and Safety Risk Analysis (Health, Safety, & Environmental)

All persons working on the site will observe all applicable rules and regulations established by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and other applicable regulatory guidelines.

Work at the site is associated with a variety of hazards, both physical and chemical. The purpose of this plan is to reduce the risks of working on the site. The preferred method is to eliminate the hazard, whenever practicable; the second choice is to use engineering controls; the Last choice is to use personal protective equipment. The general hazards to be encountered on the site, and the procedures to reduce these hazards, are presented below. The first task at the site shall be to gather miscellaneous debris scattered throughout the Work and Treatment Zones and store it in the Staging Area. Existing scaffolds and elevated walkways will be evaluated. Those items unnecessary to site operation and posing a potential hazard will be dismantled. Those items necessary to operation will be examined and repaired, as needed. Thereafter, the Project Site Manager will make weekly examinations of the structures and ensure proper maintenance. Potential site hazards have been grouped into four categories: heavy equipment, fire, other physical hazards, and chemical hazards

1.2 Heavy Equipment

Some of the most hazardous situations that may occur are associated with heavy equipment operation. The following requirements are intended to alleviate these hazards.

- ▶ Operators must be qualified on equipment; documentation will be required.
- ▶ Heavy equipment must be kept at least 15 feet away from poles that support overhead power lines.
- ▶ Back-up alarms are required.

- ▶ Personnel must make eye contact with the operator before approaching the equipment.
- ▶ Operators must wear seat belts when they are available.

1.3 Fire/Explosion Hazards

Onsite personnel may be exposed to fire/explosion hazards at any time. These hazards include:

- ▶ Excavating into underground tanks containing liquid petroleum hydrocarbons or fumes;
- ▶ Excavating into underground pipelines carrying liquid petroleum hydrocarbons or fumes;
- ▶ Dismantling and removing above-ground storage tanks containing liquid petroleum hydrocarbons or fumes;
- ▶ Generation of hydrocarbon vapor clouds during tank-emptying activities;
- ▶ Sparking of combustible petroleum hydrocarbons in the air, in soil gas, on soils; and
- ▶ Equipment fires.

1.3.1 Ignition Sources

Because of the flammable nature of hydrocarbons, ignition sources other than the treatment units will be kept out of the Work Zone and Treatment Zone:

▶ No matches or cigarette lighters are allowed in the Work or Treatment Zones. A hot-work permit will be required for open-flame work.

▶ Internal combustion engines must not be operated in the Work Zone while hydrocarbon-contaminated solids or liquids might be brought to the surface; alternatively, they must be equipped with spark arresters.

▶ Intrinsically safe hand, electrical, and mechanical (non-sparking wrenches, etc.) shall be used when working on drums and while working in the Work Zone.

▶ Explosion-proof instruments and system-wide electrical grounding will be used to prevent fires.

1.3.2 Fire Precautions

Subcontractors on the site shall comply with all requirements of this document and of the Uniform Fire Codes, and KOC-Fire & Safety Regulations in providing temporary storage of materials used in their treatment processes. All vehicles in the Work and Treatment Zones must be equipped with an appropriate fire extinguisher.

The following additional precautions will be observed to minimize the potential for fire or explosion:

▶ Excavation will proceed slowly for the first five feet to minimize damage to underground lines.

▶ Combustible gas measurements will be taken regularly during the excavation of a tank and during tank entry.

▶ Tanks shall be vented or purged before fluids are removed; if Ere, smoke, or heat emanates from any tank or excavation, personnel will evacuate the vicinity immediately; work will not resume until the signs of fire or explosion have disappeared.

▶ If total organic vapors exceed 10% of the lower explosive limit (LEL) in the Work Zone, personnel will stop work and move upwind. Measures (such as a nitrogen gas purge) will be taken to subdue combustible vapor emissions.

1.3.3 Fire-Fighting Equipment

Fire extinguishers (type BC or equivalent) and fire blankets will be located on posts throughout the Work Zone. However, *fire extinguishers are to be used only in the incipient stages of a fire*. Fire extinguishers shall be inspected periodically and maintained in operating condition.

1.3.4 No Smoking Area

No smoking is permitted within the site perimeter fence.

1.4. Other Physical Hazards

Feasible engineering controls shall be utilized to protect employees against excessive noise, in accordance with 29 CFR 1910.95 (*see Table 1-1*). The noise will be monitored throughout the site. Noise levels that exceed an 8-hour time-weighted average of 85 decibels require a haring conservation program.

1.5 Buildup of Explosive Gases

The presence of combustible/explosive gases will be monitored whenever the potential exists for their accumulation. Further action will be taken if the level exceeds 10% of the Lower Exposure Limit (LEL). The OSHA limits of employee exposure to chemicals; found primarily in 29 CFR 1910.1000, Table Z-1.

1.6. Splashes

Shower and eye wash facilities will be available in the office trailer in the event of an emergency. If the MSDS for any chemical brought onsite calls for an eyewash, an eyewash station shall be established in the immediate vicinity of that chemical's use.

1.7 Pits

The pits will be covered with netting most of the time. Work at the pits will be performed remotely whenever practical. Caution must be exercised near the pit edges. A lifeline will be available at the pit when work is in progress there.

1.8 Propane Tanks

Propane tanks shall comply with OSHA 29 CFR 1910.106 and with appropriate fire codes.

1.9 Fugitive Dust

A potential hazard on the site will be nuisance dust, especially in the warm months during windy conditions. Monitoring of airborne particulates will be performed on the site and evaluated for associated health risks. If the airborne particulate level approaches permissible exposure limits, dust-control measures will be implemented. The use of respirators will be required if the situation presents a health hazard. See Section 2.3 Heavy Metals.

2.0 Chemical Hazards

Potentially hazardous chemicals that have been detected on the site include those shown in *Table 1-2*. The maximum concentration found on the site and the location of that concentration are given. Also shown are the *recommended exposure limits* (REL.) determined by the National Institute for Occupational Safety and Health (NIOSH) and the OSHA time- weighted average *permissible exposure limits* (PEL).

2.1 Chemicals

Any chemicals brought to the site must be accompanied by *material safety data sheets (MSDSs)*, to be located in the office trailer and made available to all site personnel. Protective equipment, including eyewash stations, shall be provided as specified in the

MSDSs. Each subcontractor is responsible for providing hazard communication training to its employees regarding these chemicals.

2.2 Petroleum Products on Site

The chemical products on the site consist primarily of petroleum products. Material data safety sheets (MSDSs) will be provided for all identified products located on the site. Evaluations indicate that the most likely chemical hazard is benzene. Because analytical data may reveal the presence of sulfur and because hydrogen sulfide is a common hazard associated with crude oil, hydrogen sulfide will also be monitored. Direct reading tubes will be used to monitor for these substances.

2.3 Heavy Metals On Site

An evaluation will be performed to identify if any of the metals cited in *Table 2-1* might pose a health hazard to personnel on site. Arsenic, for example, is found in the soil and could be inhaled on particulates during dry, windy days. However, before the arsenic in the dust would exceed its permissible exposure limit, the nuisance dust itself would have far exceeded both the permissible exposure limit and tolerable levels. In other words, dust and not arsenic-laden dust—is the primary concern. If sources of contamination at higher concentrations are identified on the site, this conclusion could change. Centech is cognizant of potential exposure pathways and will be alert to new information.

3.0 Personal Protective Equipment

Level C and D protection shall be available for use on the site.

Level D protection is the minimum protection required in the Work and Treatment Zones. Level D will be satisfactory when:

- the atmosphere contains no know hazard
- the work functions contain no risk of splashing, immersion, inhalation, or contact with hazardous chemicals, and
- atmospheric concentrations are below one-half the threshold limit value for contaminants

Level D protection will consist of the following items; all of which meet applicable standards set by the American National Standards Institute (ANSI).

- sturdy work shoes or ANSI approved safety-toed shoes/boots
- hard hat
- safety glasses

Level C adds the use of respiratory protection, all certified by the National Institute for Occupational Safety and Health (NIOSH):

- full-face or half-face, air purifying respirator
- combination organic vapor/HEPA filter cartridge

Respirator protection will be required when the photoionization detector (PID) reading in ambient air exceeds 100 ppm TOV or when the dust monitor or indicator tubes reveal exposure levels exceeding permissible exposure limits. An indicator tube will be used to measure benzene concentration whenever the PID level exceeds 5 ppm above background.

4.0 Air Monitoring Program

Air monitoring will be performed in accordance with OSHA 29 CFR 1910.120(h) to evaluate air quality in order to:

- determine the appropriate protection required for site workers,
- identify areas where protection is needed,
- assess the potential health effects of exposure, and
- determine the need for specific medical monitoring
- air monitoring will also be used to establish background or baseline levels

4.1 Air-Monitoring Equipment
The equipment shown in *Table 4-1* will used. The table summarizes the intended use of each instrument, action levels, frequency of calibration, and equipment limitations.

4.2 Calibration Specifications
The equipment will be calibrated using the specifications shown in *Table 4-2.*

4.3 Personal Monitoring
To confirm that individual worker exposure is below permissible limits in Level D protection, Centech will administer a personal monitoring program. This monitoring will occur at least annually. During work operations, the person deemed to have the highest exposure to organic vapors will be equipped with personal monitoring devices to measure such chemicals as benzene, toluene, xylene, and ethylbenzene. If the monitoring reveals no dangerous exposure, then all persons performing similar work will be assumed to be safe in Level D protection.

Personal dust monitoring will be done for a person working in the most dusty area. Exposure to arsenic, lead, cadmium, and chromium will be measured to confirm that Level D protective measures are adequate.

5.0 Decontamination Procedures
Decontamination is necessary both to protect workers from hazardous materials and to minimize the transfer of these materials to clean areas or off the site. Decontamination is conducted both as a quality assurance measure and a safety precaution. Prevention is the first step:

- avoid areas of obvious contamination
- avoid getting contamination on skin or clothing
- wear disposable clothing when appropriate

All equipment entering the Work Zone shall be decontaminated before leaving the site. All persons entering the Work Zone or the Treatment Zone shall decontaminate before entering the "Clean Area". Materials generated during decontamination will be collected and disposed of in accordance with applicable federal and state regulations.

5.1 Decontamination of Personnel
A decontamination room will be available in a designated area. All persons entering the designated area from the site shall enter through the decontamination end and apply appropriate decontamination measures before entering the clean area. A change room, sink, and shower are available for use.

Disposable clothing shall be removed in the following order: boots, gloves, and then cover suit. Personnel shall place disposable clothing items in the designated waste container. Contaminated boots shall be left outside the trailer. Work boots shall be dry-brushed to remove soil. Hands shall be thoroughly washed with soap and water, rinsed, and dried.

5.2 Emergency Decontamination
Injured personnel may require decontamination before being transported to the hospital. However, if prompt, life-saving first aid and medical treatment are required, decontamination procedures should be omitted. Response personnel should accompany contaminated victims to the medical facility to advise on matters involving decontamination.

If the situation permits, the outside garments can be removed. Respirators and backpack assemblies must always be removed. Chemical-resistant clothing can be cut away. If outer contaminated garments cannot be safely removed, the individual should be wrapped in plastic, rubber, or blankets to help prevent contamination of the ambulance and medical personnel. Do not wash or rinse victim at the site, unless it is known that the individual has been contaminated with an extremely toxic or corrosive substance that could cause severe

injury or death. For minor medical problems or injuries, use the normal decontamination procedures.

5.3 Decontamination of Sampling Equipment

All sampling and monitoring equipment used on the site will be decontaminated under the procedures specified in the WWC Standard Operating Procedure #89-05, contained in Appendix B.

▶ Standard Procedures

1) Remove any solid particles from the equipment or material by brushing and then rinsing with tap water. This initial step removes gross contamination.
2) Wash equipment with soap or detergent solution.
3) Rinse with tap water.
4) Rinse with distilled or deionized water.
5) Repeat entire procedure or any parts of the procedure if necessary.
6) Allow equipment to air dry before re-using. If equipment is not used immediately, wrap in aluminum foil to prevent the equipment from becoming re-contaminated.
7) Contaminated materials and any wash water should be containerized and properly disposed of or treated.

▶ Specific Decontamination Procedures (Submersible Pump)

The following procedure will be used to decontaminate submersible sampling pumps prior to each use.

A) Materials

-- plastic upright cylinder (drum or capped length of pipe)
-- 5-10 gallon plastic storage containers
-- acetone and dispenser bottle
-- deionized water and dispenser bottle
-- chemical-free paper towels
-- clean plastic sheeting

B) Procedure

1) Clean the upright plastic cylinder with appropriate cleaning solution and/or solvent, followed with a deionized water rinse. Wipe off any free liquids after each rinse.
2) Remove the pump from the previous well if necessary. Wipe the power cord and discharge line dry with chemical- free disposable paper towels.
3) Reverse pump to backwash residual liquid in the pump tubing. The pump should be shut off as soon as intermittent flow is observed from the reverse discharge.
4) Place the pump on a clean surface or hold off of the ground.
5) Wash and rinse the stainless steel submersible down-hole pump section with liberal applications of the appropriate solutions and/or solvents and wipe dry.
6) Place the submersible pump section upright in the cylinder and fill the cylinder with tap water, adding appropriate amounts of cleaning solution.
7) Activate the pump in the forward mode, withdrawing water from the cylinder.
8) Continue pumping until the water in the cylinder is pumped down and air is drawn through the pump. Shut off the pump immediately.
9) Remove the pump from the cylinder and place the pump in the reverse mode, allowing all removable water to be discharged as cited in item 4 above.
10) Using the water remaining in the cylinder, rinse the sealed portion of the power cord and discharge tube by pouring the water carefully over the coiled lines.
11) Place the pump in the well casing and wipe both the power and discharge lines dry with clean paper towel.

To ensure the efficiency of decontamination procedures, a specified number of equipment field blank samples shall be collected using cleaned submersible pump. The blank will be analyzed for the same parameters as the ground-water samples.

SECTION SIX
PART 8

HSE AUDITING PROGRAM

Supporting documentation for lessons learned from past incidents cited at the end of this section.

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HSE AUDIT

HEALTH, SAFETY & ENVIRONMENT AUDIT PROGRAM

The Centech International HSE Audit Program will be comprised of teams of professionals from Corporate and the businesses. Where teams cannot be assembled due to availability of resources or need of special expertise, contractors will be used to supplement the audit team. Annual budgets should include funds for audit participation.

Management Systems
Management Systems provide the foundation for a consistently effective HSE process; guidance and direction for employees and organizations; expectations that are understood; and a method of controlling occupational injuries / illnesses, environmental incidents and costs.

HSE Management Systems
- Management Commitment & Direction
- Employee Roles and Responsibility
- Hazard Control & Risk Assessment
- Laws and Regulations
- Education and Training
- HSE Communication
- Rules & Procedures
- Emergency Planning and Medical Surveillance
- Documents & Records
- Contractor and Vendor (Supplier) Management
- Product Safety
- Security & Travel Safety
- Audit and Inspections
- Incident Investigation & Reporting
- Process Assessment & Improvement

HSE Management Systems Audit Process
- Opening Conference
- Executing the HSE Management Systems Audit
  - ✓ reviewing the site’s existing HSE process
  - ✓ evaluate how the site is executing CI's HSE Management Systems
  - ✓ interview employees at all levels of the organization; and verify and provide recommendations to improve the site’s HSE process
- Put together “DRAFT” report and score
- Closing Conference
- Six (6) month follow-up reviews

HSE Management System Audit Scoring

Each HSE Management System element receives a score. This helps the site prioritize their resources and what to focus on first.

The site receives an overall Audit score. This provides the site with a baseline of how well they are executing Centech International HSE Management Systems.

Scores are also being used to validate our Safety Management Systems -- (score compared to site performance)

HSE Management System Closing Conference

The HSE Audit Team will review the draft report which includes:

- the site's present status as it relates to their HSE process
- recommendations identified to improve their HSE process scores (individual and overall)

Site responsibilities include:

- developing an action plan for recommendations
- submit final report and action plan to division manager and Corporate Director EHS
- Six (6) month reporting via database

HSE Management System Audit Database

- ❑ Access Database Program
- ❑ Contains all aspects of the HSE Management Systems Audit Program
  - ✓ HSE Management Systems Questions
  - ✓ Field Notes
  - ✓ Final Report
  - ✓ Recommendation Reports
  - ✓ Tracking of "open" audit findings
  - ✓ Generates charts and graphs

LESSONS LEARNED

1. *Centrifuge Expert Fuzzy Logic Intelligence:*

Because the s&w content of reclaimed oil must be below a particular limit, feed rate and feed temperature must be adjusted accordingly. Designated an automatically controlled three-phase centrifuge, Centech combines an expert fuzzy controller with a centrifuge. Running on a portable to ensure computer, the fuzzy controller duplicates human expertise in operating the machine. The controller is based on artificial intelligence (for the analysis of expert judgment) and adjusts operating conditions to give consistency to the quality of recovered oil, reduces maintenance & process costs, allows continuous measurement and simultaneous changes of important parameters such as (s&w, feed temperature, and feed rate); and eliminates the need for numerous time-intensive sample collections & analysis per day. The automatic controller gives the centrifuge a competitive edge in the steadily growing environmental clean-up market minimizing the need to change the properties of waste prior to treatment and serving as an effective tool in training operators in centrifuge waste remediation.

See Attached Documentation:

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FUZZY SPC FILTER FOR A FEED-FORWARD CONTROL SYSTEM FOR A THREE-PHASE OIL FIELD CENTRIFUGE

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ABSTRACT—In this work we describe a signal filter for a feed-forward controller based on the application of fuzzy logic, combined with statistical process control (SPC). The feed-forward controller is for a three-phase oil field centrifuge. The centrifuge system is used to separate meta-stable three-phase oil and water emulsions that are stabilized by solids. These emulsions are considered to be unusable wastes and must be disposed of in an environmentally acceptable manner. The centrifuge is capable of turning these wastes into clean saleable oil, water that can be reused in an operating process or re-injected into oil wells, and solids that can be disposed of in landfills.

The feed-forward controller is used for feed disturbance rejection. It works in conjunction with, and is capable of over-riding the actions of, a feedback controller. The measured feed variables for the feed-forward controller each exhibit reasonably large random fluctuations. It is therefore quite important to use a signal filter that truly recognizes the difference between random noise and a "caused" event, in order to prevent over-riding a perfectly good correction from the feedback controller.

Key Words: centrifuge, fuzzy logic, feed-forward control, signal filter, statistical process control (SPC)

1. INTRODUCTION

The three-phase centrifuge described in this study is a one-of-a-kind portable system used in oil fields to recover oil and eliminate wastes from tank bottoms. These wastes are not considered hazardous. The centrifuge system is also used in refineries to recover oil and eliminate waste from refinery residue. These wastes are often considered hazardous. The feed to the centrifuge system is quite different in each of these cases. In fact, the feed in the oil field can vary dramatically from field to field, as it also does from refinery to refinery. This variable feed requires an adaptable filter for the signals to the feed-forward controller.

The centrifuge feed will vary from site to site. Feeds can also change dramatically during even a single day of operation at any one site. Feed changes in the past have sometimes been so dramatic that they have plugged the centrifuge and shut the system down because the feedback control system did not change the operating parameters quickly enough.

The system should respond only to true changes and not to noise. The sampled systems are quite noisy; therefore, noise is part of the sampled variable. There is also sensor noise. In order to differentiate between true change and noise, we implemented an SPC control chart technique. The control charts used in this case were *Individual* and *Moving Range* charts [1]. Initial control charts are established each day at the beginning of a run as soon as steady-state operation is established. The control chart calculations determine

an average *Individual* sample from a run of about thirty samples. Control limits are established around the average value. The operator can set these limits for specific feed conditions, or use standard two and three sigma limits. The control chart calculations also establish an average *Moving Range* and upper control limit. These control charts are usually used for just one variable, but in our case we must measure three dependent variables; feed flow rate change, feed heater power requirement change, and the change in the feed basic sediment and water (BS&W) content. We must then determine if the combination of changes are noise or real feed property changes. For this purpose, we use a fuzzy rule-based system to determine a value for the *Feed-Change-Magnitude.* This is the value we used with the control charts. If the *Individual* values stray beyond the control limits, the *Feed-Change-Magnitude* is considered to be significant, and the feed-forward control is implemented. If the *Moving Range* data go beyond the control limits, it usually means a rapid short-term change or that sensor difficulties are coming into play. The *Moving Range* chart is available to the operator, but currently no automatic control action is implemented based on *Moving Range* data.

2. BACKGROUND – CENTRIFUGE DESCRIPTION

This centrifuge control problem provides an excellent demonstration for the use of fuzzy logic control. The separation of three physical phases by use of a centrifuge is difficult, if not impossible, to model mathematically because it is extremely nonlinear and complex. Since modeling is out of the question, it is difficult to apply classical PID techniques to solve the control problem. The centrifuge, however, in the past has been kept under control by manual techniques applied by an expert operator. Rather than modeling the centrifuge, we modeled the expert operator using fuzzy logic expert knowledge techniques.

This technique worked well and demonstrated the utility of fuzzy logic on a class of problems not easily solved by classical techniques.

The control system includes a feed-forward controller, a fuzzy-SPC filter (the subject of this paper), a fuzzy soft-sensor, and a fuzzy conflict resolution code that all work in consort with a fuzzy feedback controller.

Centech, Inc. has developed a novel, three-phase centrifuge process for the recovery of oil from tank bottoms and sludge. The process was the winner of a 1993 R&D 100 award and is protected by a 1992 patent [2]. Centech has been in business for over a decade using this technology to successfully treat nearly 1,000,000 barrels of tank bottoms and sludge including completion/work over, production, industrial, and refinery wastes. The process equipment is a one-of-a-kind, three-phase decanter centrifuge that only trained Centech personnel can successfully operate. Documented results show that this three-phase centrifuge is capable of separating tank bottoms and sludge into three product streams: pipeline quality oil, water with 2-3ppm total dissolved hydrocarbon, and land-fillable solids [3]. Unlike similar techniques, the Centech process can often achieve these separation levels without the addition of any separation-enhancing chemicals. The economic analysis of a field test near Hobbs, New Mexico demonstrated that the revenue received from the sale of the recovered oil negated the cost of the service, resulting in a break-even venture. The economic analysis did not include the reduction in liability associated with the reduction in waste volume. These savings normally amount to much more than the profit from selling the cleaned oil. However with dwindling oil reserves and rising oil prices, the money obtained from oil sales becomes significant. Figure 1 shows the Centech centrifuge during a field test at the Hobbs, New Mexico site.

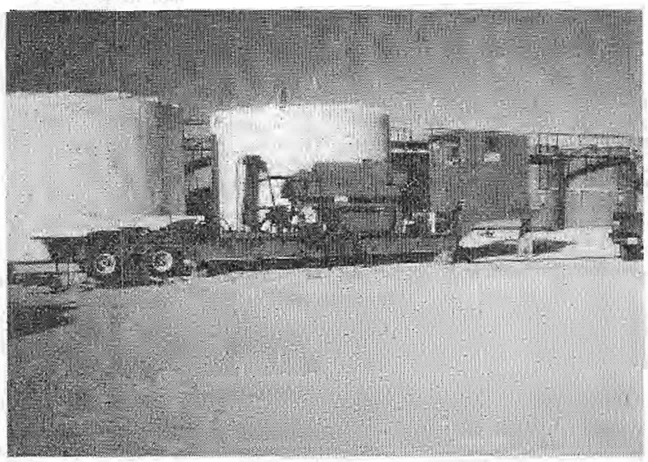

Figure 1. The Centech centrifuge on site in Hobbs, NM.

Figure 2 shows the centrifuge internals. The centrifuge consists of a spinning bowl that creates the centrifugal force that in turn provides the separation. This bowl is outlined in black and includes both the

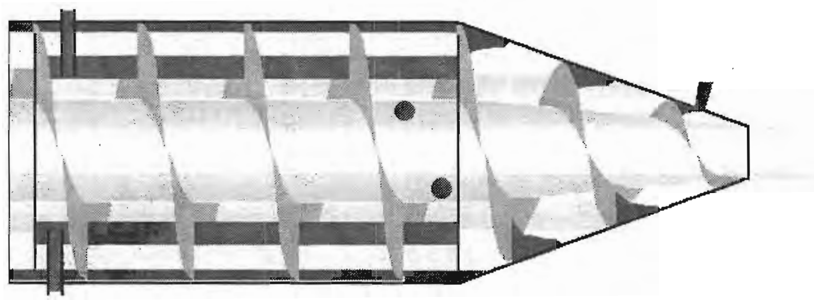

Figure 2. Centrifuge internals.

cylindrical and conical sections of the centrifuge. The inlet components are separated by density (by centrifugal force) with the solid (shown as the dark colored phase near the outside wall of the centrifuge) being the densest. The water (shown as the lighter phase in the middle) is next in density. And the oil (shown as a dark phase near the auger) is the least dense. The auger is the fluted cylinder in the center of the centrifuge. The feed mixture enters the centrifuge through ports on the auger, shown as two dark dots in the figure. The auger spins at a different rotation speed than the bowl, continuously expelling the clean solids. Adjustable weirs control both liquid levels. The oil and the water are continuously being removed. Figure 3 shows the major components of the centrifuge system.

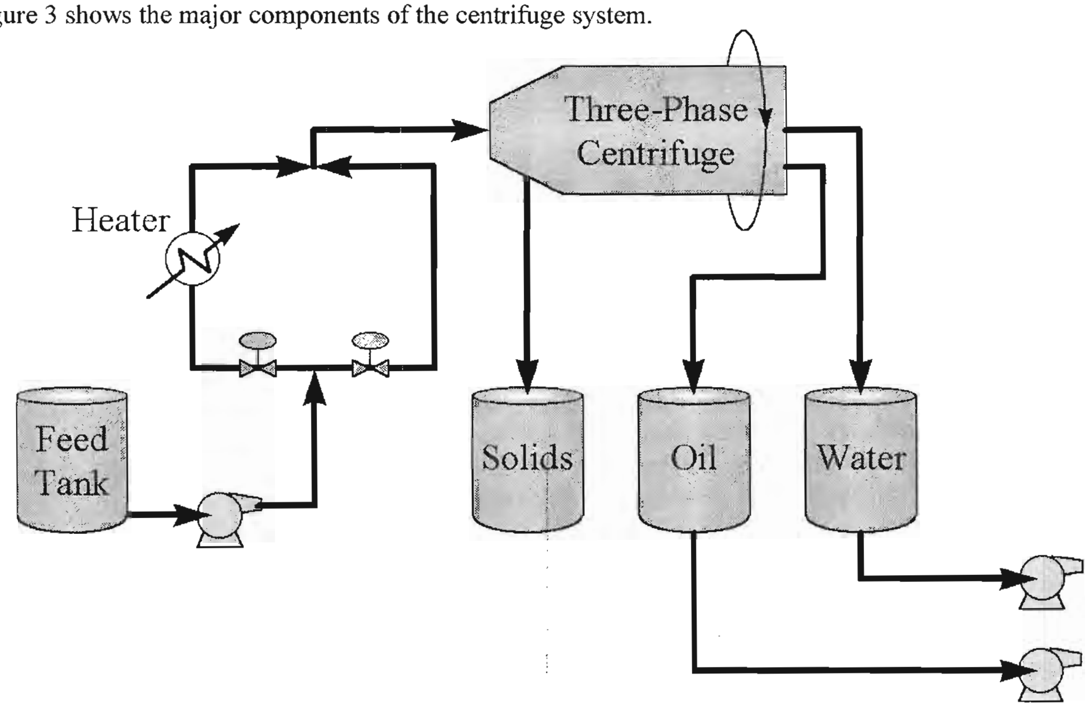

Figure 3. Schematic diagram of the centrifuge system.

The main components of the system are the centrifuge, the feed pump, feed heater, and product tanks. Sometimes the system includes a feed tank, but often the feed is taken directly from a waste pit or pond. The three controlled variables are the basic sediment and water (BS&W) in the product oil, the hydrocarbon content of the product water, and the hydrocarbon content of the product solid. The impurity limits for these three streams vary from state to state (in the United States) and sometimes even from site to site. For example, New Mexico requires the BS&W content of the oil to be 1% or less in order to be pipeline quality while Wyoming requires 0.3% or less. The major manipulated variables that affect this control are the feed pump speed, the feed temperature, the bowl speed, and the auger speed. Unfortunately, the current version of the centrifuge requires that it be shut down in order to change the bowl speed. At the

present time, most of the control is accomplished by manipulating the feed pump speed and feed temperature.

The Centech technology provides an excellent solution to a serious environmental problem. It is capable of turning a waste product that is sometimes considered hazardous into a much needed and saleable product, pipeline grade oil. But, at least one hurdle must be overcome before Centech can offer this technology globally: The expertise of the Centech personnel must be encapsulated into an intelligent setup and control system paradigm. The Centech centrifuge is a highly nonlinear multi-input, multi-output system. Tank bottoms and sludge differ from site-to-site and tank-to-tank, resulting in unique and varying control parameters for each material processed. Figure 4 shows a typical pit containing waste oil. This particular pit is located near Hobbs, New Mexico. The 500-ft x 200-ft x 90-ft deep pit contains about one million barrels of oil that are tied up as an oil-water-solid emulsion. In many places this oil would be considered a hazardous waste, but after treatment by the centrifuge, it will be saleable at the current market price.

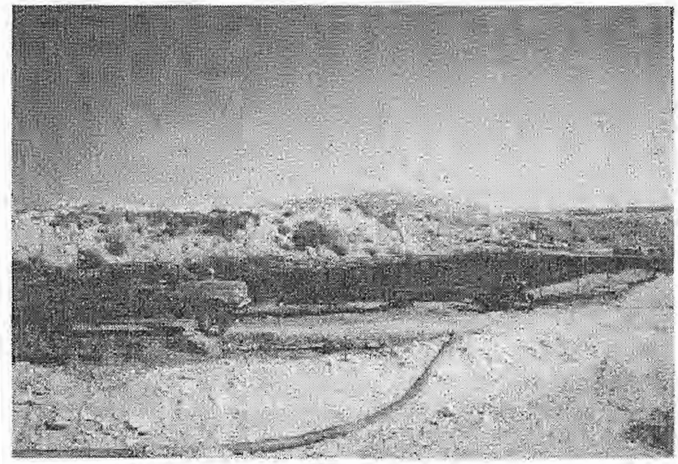

Figure 4. A typical waste oil pit.

3. THE CONTROL SYSTEM

Currently Los Alamos National Laboratory control engineers are working with Centech Inc. The Los Alamos team has designed and is implementing a control system for the centrifuge based upon the expert knowledge of the Centech operators. The resulting expert-based control system, through the implementation of fuzzy logic, controls the quality of the oil produced by manipulating only the throughput and temperature of the feed. We chose a fuzzy logic control system for two reasons:

1. Even though one objective of the original project was to develop a centrifuge model, the system proved too complex. The model that was developed was not adequate for control purposes.
2. Under almost all circumstances it is entirely possible for an expert operator to maintain excellent control of the centrifuge system. The expert's description of his control actions was almost identical to a textbook description of a fuzzy expert system.

Therefore, we chose to model the expert rather than the centrifuge, using a fuzzy expert system.

The overall control system combines feed-forward control with a feedback control system as shown in Figure 5.

This system includes a "fuzzy-statistical process control (SPC) filter" and the conflict resolution program. We use the feed-forward controller to detect large changes in the feed that require process control adjustments before a major problem is encountered. This is important for proper control of Centech's centrifuge. An example condition that requires feed-forward adjustment is when feed material collects in stratified layers in the feed tanks or ponds. In the case where the operator is lucky enough to be working with feed tanks, he can often "roll" or mix the tanks in the morning. This step, though time consuming, provides a consistent feed for a period of time. Often however, by afternoon the feed tank will have settled, forming layers of different consistency. This scenario is shown in Figure 6. Another less common example, which has actually happened, is when the bank on the feed pond caves in and actually increases the BS&W content of the sludge in the feed pond. These events can cause serious control problems of the disturbance rejection type. The *disturbance rejection* problem is the reason for the feed-forward controller. The fuzzy-SPC filter is required because the feed signals are quite "noisy." We don't want to make changes to the control variables in advance unless they are truly required. The fuzzy-SPC filter differentiates between noise in the measured feed variable and a true change in the feed.

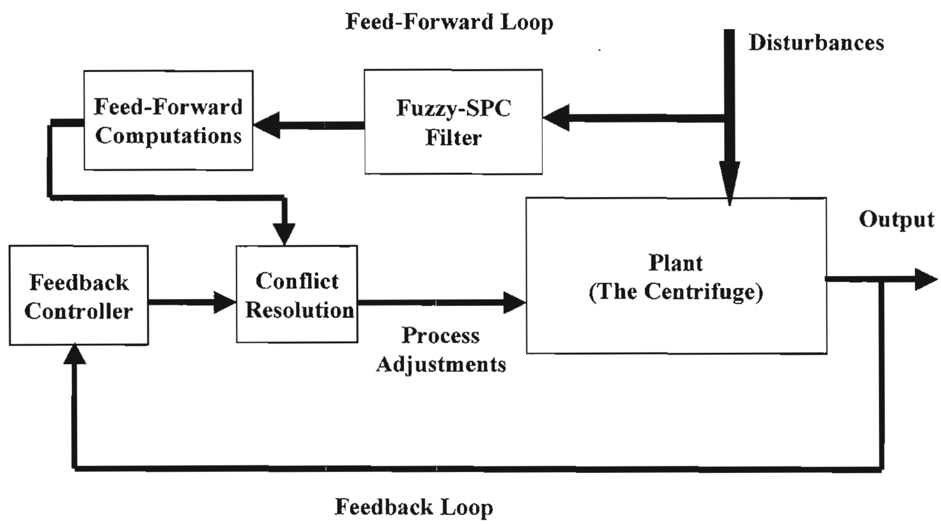

Figure 5. Block flow diagram for the combined feed-forward and feedback control systems.

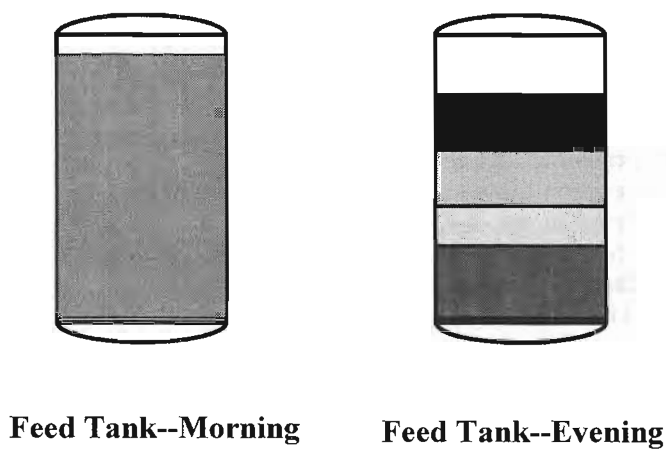

Figure 6. View of the feed tank after mixing in the morning versus a view of the feed tank after settling during the day.

The feedback control system is continually working, making adjustments to the process after detecting a product change. The conflict resolution portion of the controller makes sure that corrections to the process, due to both feedback and feed-forward conditions, are compatible with the goals of both controllers. The feed-forward portion of the controller usually dominates these corrections because feed-forward events are future events, and only significant events are acknowledged because of the filter. However, some weight is given to current action governed by the feedback controller.

The fuzzy-SPC filter is a rather unique device to filter out the sensor noise, but it is quite appropriate for the centrifuge system, since the system time constant is in the order of minutes rather than seconds. The technique is computational intensive and would be too slow for a system requiring rapid control action. The fuzzy-SPC filter is based on the *Individual* and *Moving Range* charts similar to the X bar-R charts from the discipline of statistical process control (SPC). Our technique uses fuzzy logic because several variables are monitored at a time rather than just one in the usual SPC case.

The feed-forward computations, shown in Figure 5, are broken into two parts, the fuzzy soft-sensor and the fuzzy feed-forward controller. This combination is shown in Figure 7.

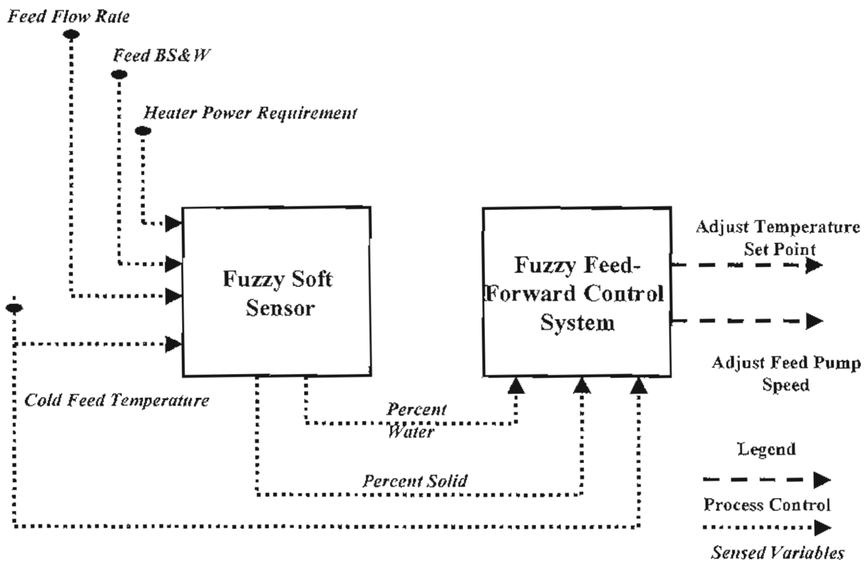

Figure 7. Flow diagram for the fuzzy feed-forward control system and fuzzy soft-sensor.

The feed-forward control system requires three input variables to determine what adjustments, if any, are required for the feed pump speed or flow rate and the feed temperature setpoint. These variables are the cold feed temperature, percent change of water in the feed, and percent change of solid in the feed. Unfortunately the percent change of water in the feed or percent change of solid in the feed cannot be measured. However the percent change of BS&W in the feed can be measured. It is the sum of the water and solid change. The change in the power requirement for the feed heater to maintain a given setpoint temperature, and the change in the volumetric flow rate can both be measured. Based upon these measurements, the feed BS&W measurement and some knowledge of the cold feed temperature changes, the expert can determine the extent of the changes in feed water content and feed solid content. This expert knowledge is incorporated into the fuzzy soft-sensor.

We were able to construct a computer model of the feed system, although only an approximate one, because the feed system can be described by relatively simple fluid flow laws. This is not true of the centrifuge itself, however, which is extremely difficult to model. The computer model of the feed system was not in the form required for the feed-forward controller, but it did provide some simulation capability and was used to extend the expert knowledge required for the soft-sensor.

The individual elements of the control system are:

- The fuzzy-SPC filter.
- The fuzzy feed-forward controller.
- The fuzzy soft-sensor.
- The fuzzy feedback controller.
- The conflict resolution code.

Next we'll describe the fuzzy SPC filter. The other control elements are described elsewhere [4].

4. THE FUZZY-SPC FILTER

We designed the filter to prevent the feed-forward controller from acting upon feed changes that are really just system "noise". The filter is an implementation of a fuzzy version of the statistical process control (SPC) charts known as *Individual* and *Moving Range* charts. These charts were patterned after the more commonly used X bar-R charts. Dr. Walter Shewhart [5, 6] developed both types of control charts for quality control in the 1920s. The X bar-R charts and their fuzzy analogs are discussed in more detail by Parkinson [4]. Figures 8 and 9 show an *Individual* chart and a *Moving Range* chart, respectively. We developed these charts using a computer model of the centrifuge feed system and a random number

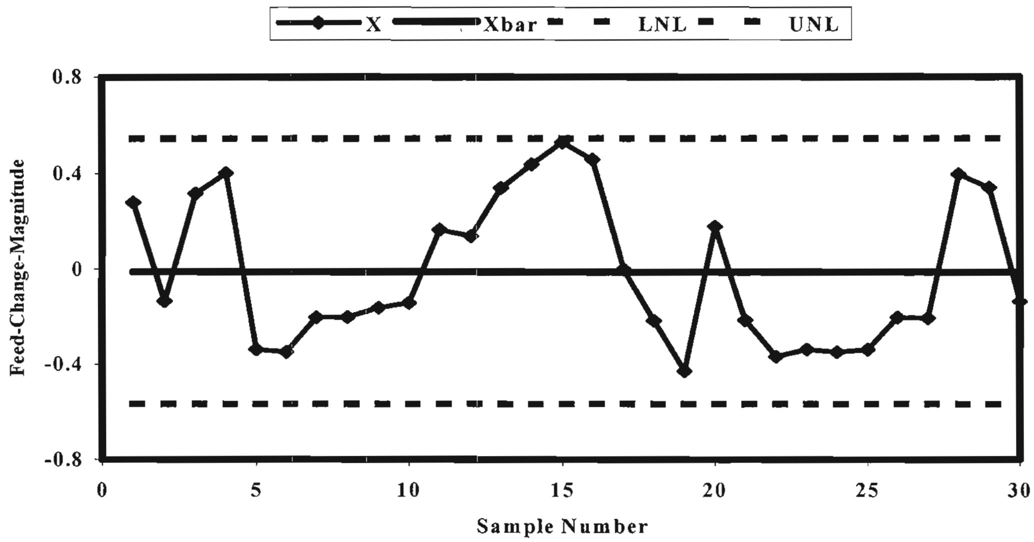

Figure 8. The *Individual* chart for *Feed-Change-Magnitude* for the fuzzy-SPC filter.

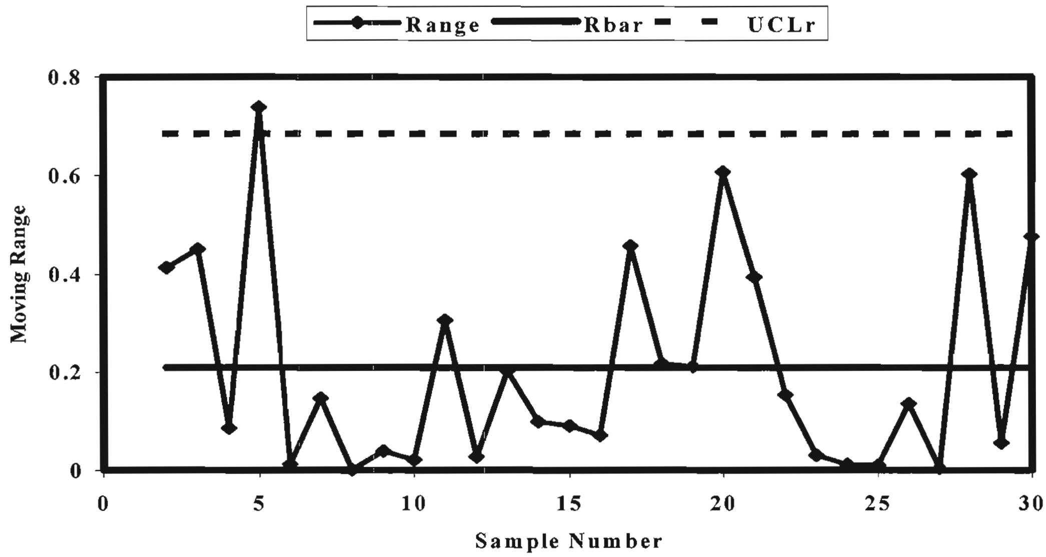

Figure 9. The *Moving Range* chart for the fuzzy-SPC filter.

generator, rather than proprietary field data. In practice the SPC version of this technique works quite well [1,7,8]. For this work and the information displayed in Figures 8 and 9, we have modified the SPC technique to include fuzzy logic. The reason for the modification is that the expert operator normally looks for indications that the feed BS&W has changed by a magnitude of at least ±10% before implementing a manual feed-forward control. The control system can measure this with the feed BS&W meter. However, this is not the whole story. The feed water concentration and feed solid concentration can change in opposite directions, making the feed BS&W reading lower than ±10%. The feed-forward controller relies on knowledge of the water and solid changes individually, not the total BS&W change. A fuzzy soft-sensor determines the magnitude of the individual water and solids changes, from knowledge about feed pump flow changes and feed heater power requirement changes in addition to the total feed BS&W change. Our fuzzy filter incorporates these three variables into a single variable that we call *Feed-Change-Magnitude.*

This is the variable used with the SPC technique, rather than just the feed BS&W change. In our situation, these charts are developed in the field each workday at the beginning of a run and after steady-state operation has been achieved.

We construct the *Individual* and *Moving Range* charts in the following manner:

- Data sets, consisting of feed pump flow, heater power requirements, and feed BS&W are taken at a specified sample interval (depending upon the current centrifuge operation—currently from 10 seconds to about a minute.) If a temperature change occurs, the sample is corrected for temperature. The differences in each succeeding set for the three variables are computed. These differences are called *Variable Changes* e.g., *Feed BS&W Change.*
- The *Variable Changes* are used with the fuzzy rules shown in Table I and the corresponding input and output membership functions to produce the variable called *Feed-Change-Magnitude*. This is the *Individual* variable plotted in Figure 8. Note that each point on the *Individual* chart is determined exactly like the point in the example in the next section is determined. At each step, the difference between the current *Feed-Change-Magnitude* and the previous *Feed-Change-Magnitude* is computed. This is the *Moving Range* value plotted in Figure 9.
- After thirty set measurements (five minutes to half an hour), the *Individual* and the *Moving Range* averages ($\overline{X}$ and $\overline{mR}$) can be computed.
- The upper and lower control limits for the *Individual* chart, sometimes called the upper and lower natural limits, designated UNL and LNL respectively, in Figure 8, are computed from Eqs. 1 and 2. The upper control limit for the *Moving Range* chart (designated UCLr in Figure 9) is computed from Eq. 3. These control limits are essentially three standard deviations above and below the mean or average lines.
- If the *Individual* values stray beyond the control limits, we assume that the *Feed-Change-Magnitude* is significant and the fuzzy soft-sensor and feed-forward control is implemented.
- If the *Moving Range* data go beyond the control limits, it usually means either a rapid short-term change or that sensor difficulties are coming into play. The *Moving Range* chart is available to the operator, but currently no automatic control action is implemented based on *Moving Range* data. This may change in the future.

$$UNL = \overline{X} + 2.660\overline{mR} \tag{1}$$

$$LNL = \overline{X} - 2.660\overline{mR} \tag{2}$$

$$UCLr = 3.268\overline{mR} \tag{3}$$

Figure 8 shows that the feed composition generated by the computer model does not stray beyond the control limits. This means that the fuzzy soft-sensor and the feed-forward controller would not be activated by any of the information generated by the computer model for this example. However, the trend indicated by points 12 through 16 show the system was moving "out of control" in that time interval. In Figure 9, the *Moving Range* chart, the point generated from sample number five is beyond the upper control limit. This comes from an abrupt but small reverse in sign for the change in the feed BS&W. With actual data this could be an early warning of an impending feed composition change.

The *Feed–Change-Magnitude* is computed with a fuzzy rule-based system. One reason for using the fuzzy technique is the multi-variable nature of the feed. The soft-sensor uses four input variables to compute two output variables, percent change in water, and percent change in solid, required by the feed-forward controller. All four of those variables, feed temperature, feed flow rate, feed BS&W, and feed heater requirements, exhibit random noise and are not independent. It is easy to correct for the feed temperature change. If necessary, the temperature correction is made and then the other three Change Variables; *Feed Flow Rate Change, Feed BS&W Change*, and *Feed Heater Requirement Change* are used with the fuzzy rule base to compute the *Feed-Magnitude-Change.* Our fuzzy system has twenty-seven rules, three input variables with three input membership functions each and, one output variable with five output membership functions. The rules are of the form:

If the *Feed Flow Rate Change* is… and the *Feed BS&W Change* is… and
the *Feed Heater Requirement Change* is…Then the *Feed-Change-Magnitude* is…

Table I. Rules for the Fuzzy-SPC filter.

Rule Number	If (Feed Flow Rate Change) is	and (Feed BS&W Change) is	and (Feed Heater Requirement Change) is	Then (Feed-Change-Magnitude) is
1	Negative	Negative	Negative	Large Negative
2	Negative	Negative	Zero	Large Negative
3	Negative	Negative	Positive	Small Negative
4	Negative	Zero	Negative	Large Negative
5	Negative	Zero	Zero	Zero
6	Negative	Zero	Positive	Zero
7	Negative	Positive	Negative	Large Positive
8	Negative	Positive	Zero	Large Positive
9	Negative	Positive	Positive	Small Positive
10	Zero	Negative	Negative	Large Negative
11	Zero	Negative	Zero	Small Negative
12	Zero	Negative	Positive	Large Negative
13	Zero	Zero	Negative	Small Negative
14	Zero	Zero	Zero	Zero
15	Zero	Zero	Positive	Small Positive
16	Zero	Positive	Negative	Small Positive
17	Zero	Positive	Zero	Small Positive
18	Zero	Positive	Positive	Large Positive
19	Positive	Negative	Negative	Large Negative
20	Positive	Negative	Zero	Large Negative
21	Positive	Negative	Positive	Large Negative
22	Positive	Zero	Negative	Small Positive
23	Positive	Zero	Zero	Small Positive
24	Positive	Zero	Positive	Large Positive
25	Positive	Positive	Negative	Small Positive
26	Positive	Positive	Zero	Large Positive
27	Positive	Positive	Positive	Large Positive

All of the input membership functions are ternary—*Positive*, *Zero*, and *Negative* changes. The output has five membership functions *Large Positive*, *Small Positive*, *Zero*, *Small Negative*, and *Large Negative*. These membership functions are normalized between -1 and 1. The membership functions are described by the simple triangles and trapezoids and are shown in Figures 10 through 13.

The upper and lower natural control limits, derived from input data and computed from Eqs. 1 and 2, shown in Figure 8 are 0.5449 and –0.5692, respectively. Currently, we use these values as the control limits for a "go" or "no-go" decision for feed-forward control adjustment. We can use any value we wish for the actual control limit, but we will get too many "false alarms" if the actual control limits are smaller than those used here.

Table II lists four "disturbance" process conditions generated by the simulation code. These conditions were all intended to pass through the fuzzy-SPC filter to the feed-forward controller. The last column in Table II is the *Feed-Change-Magnitude*. The numbers in the last column are either greater than 0.5449 or less than –0.5692.They fall outside of the dotted lines shown in Figure 8. Sample number four would not have passed the normal SPC filter test with the expert operator's criterion of ±10% change for the feed BS&W. The feed-forward controller should act upon this sample since the individual feed water concentration and feed solid concentration varied significantly. The expert operator, using manual control, might decide these changes are significant by noticing changes in other process variables, and then apply appropriate control action. The automatic system has to work with very carefully spelled out directions in order to do at least as well as the expert operator.

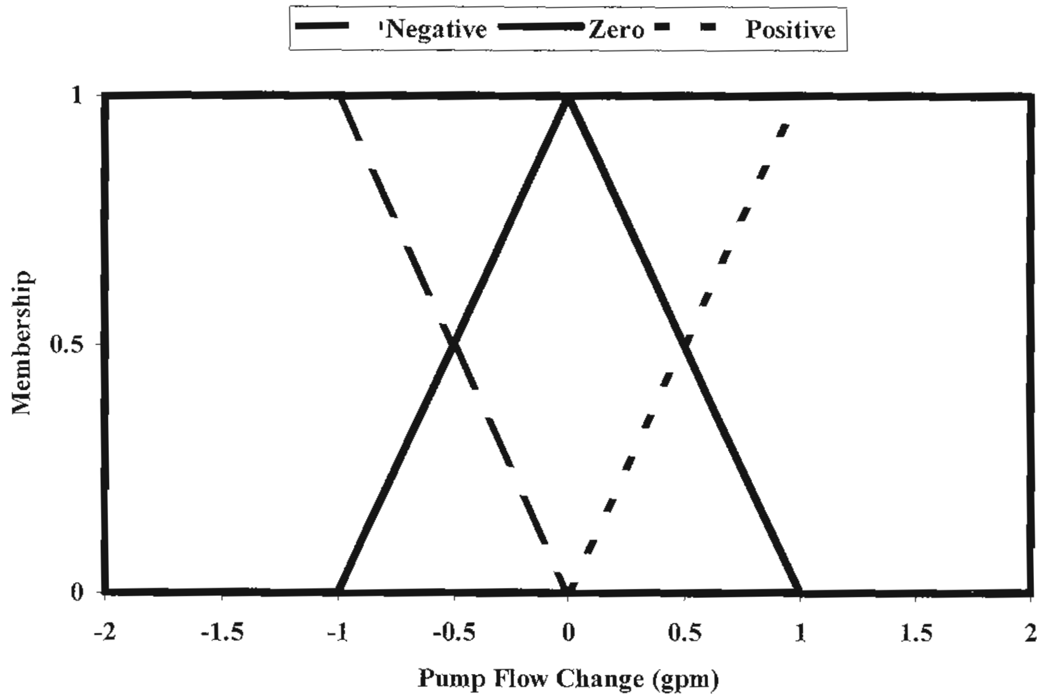

Figure 10. The input membership functions for the variable *Pump Flow Change* for the fuzzy-SPC filter.

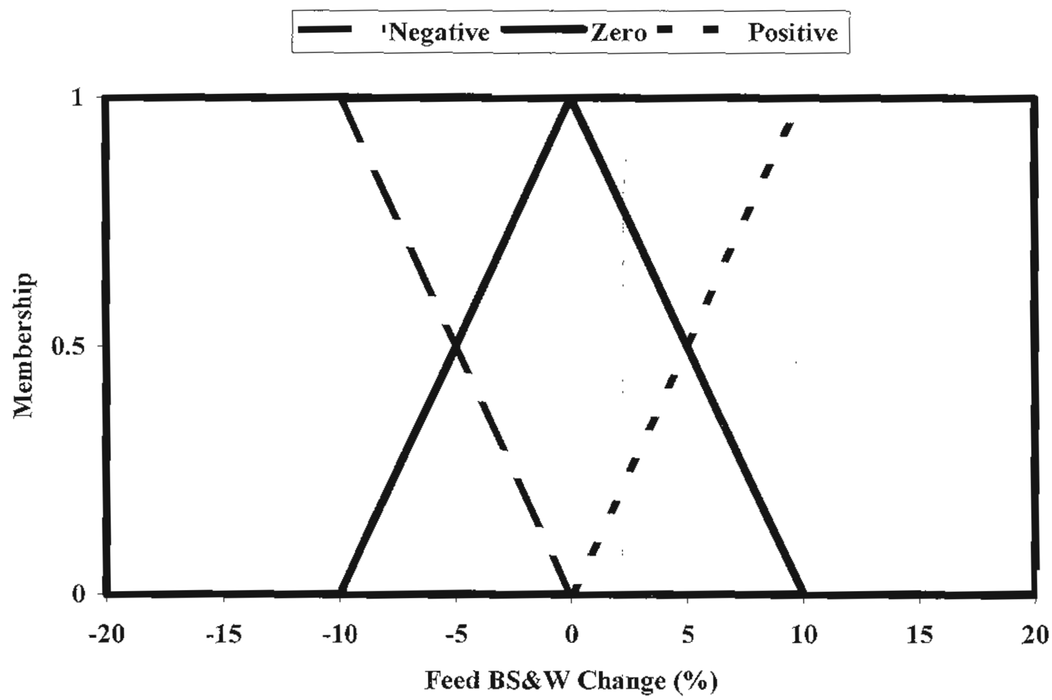

Figure 11. The input membership functions for the variable *Feed BS&W Change* for the fuzzy-SPC filter.

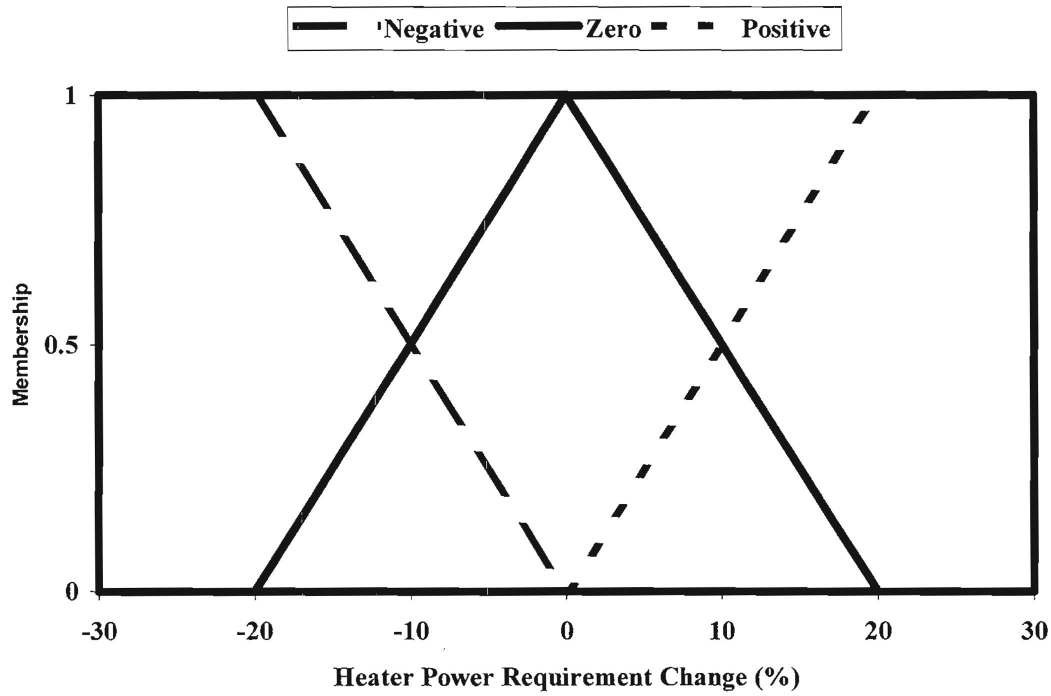

Figure 12. The input membership functions for the variable *Heater Power Requirement Change* for the fuzzy-SPC filter.

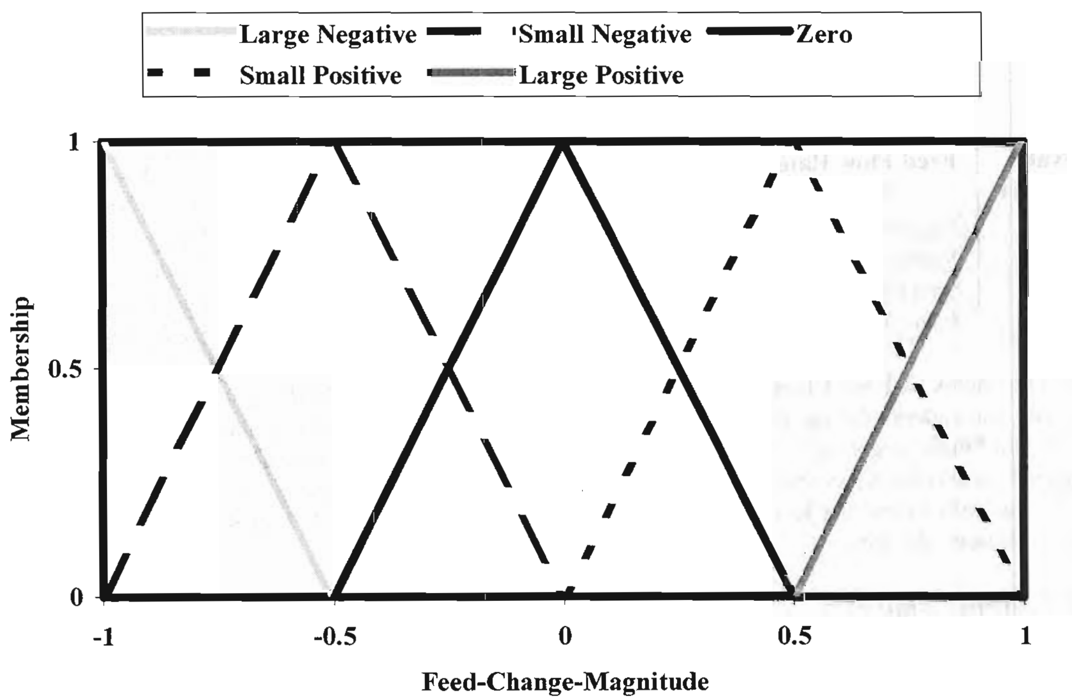

Figure 13. The output membership functions the variable *Feed-Change-Magnitude* for the fuzzy-SPC filter.

Table II. Simulated Feed Conditions and Operating Parameters with the Computed *Feed-Change-Magnitude* that Allowed Passage Through the Fuzzy-SPC Filter.

Sample No.	Flow Rate Change (gpm)	Feed BS&W Change (%)	Heater Power Requirement Change	Percent Water Change	Percent Solid Change	Feed-Change-Magnitude
1	-0.9868	-15.0	-24.9072	-10.0	-5.0	-1
2	-0.5730	-10.0	-7.3806	0.0	-10.0	-0.7793
3	0.0909	10.0	0.0142	0.0	10.0	0.5611
4	1.5198	5.0	33.7269	10.0	-5.0	1

5. EXAMPLE

With the simulator, we drop the solid content of the feed by –10%. The feed BS&W meter records a drop of –10% BS&W in the centrifuge feed. At this point the meter does not know whether the drop is from solid or water or both. The feed pump flow rate drops by –0.573 gpm, because solids are harder to pump than water and oil. The feed heater requires less power by –7.3806 % because solids are generally easier to heat than water. These are the numbers registered in row 2 of Table II. Using these values of Flow Rate Change, Feed BS&W Change, and Heater Power Requirement Change with Figures 10—12, we obtain the following memberships:

1. Pump Flow Change – Negative = 0.573
2. Pump Flow Change – Zero = 0.427
3. Feed BS&W Change – Negative = 1.0
4. Heater Power Requirement Change – Negative = 0.369
5. Heater Power Requirement Change – Zero = 0.631

Only four rules are fired, rules 1, 2, 10, and 11 as shown in Table III.

Table III. Rules Fired in the Example Problem.

Rule Number	Feed Flow Rate Change	Feed BS&W Change	Feed Heater Requirement Change	Feed-Change-Magnitude
1	Negative (0.573)	Negative (1.0)	Negative (0.369)	Large Negative (0.369)
2	Negative (0.573)	Negative (1.0)	Zero (0.631)	Large Negative (0.573)
3	Zero (0.427)	Negative (1.0)	Negative (0.369)	Large Negative (0.369)
4	Zero (0.427)	Negative (1.0)	Zero (0.631)	Small Negative (0.427)

The values of Feed-Change-Magnitude in the last column of Table III take on the minimum value of the rule antecedents by virtue of the max-min inference method. The final values are Large Negative = 0.573 and Small Negative = 0.427 from the max portion of the rule. The output membership functions are "clipped" accordingly, as shown in Figure 14. The centroid of this figure is –0.7793 as shown in Table II. This value falls below the lower dotted line, or control limit, in Figure 8. Therefore information is allowed to pass through the filter.

5.1 Control Comments

The experienced control engineer may have noticed by this time that there is a rather non-ideal situation in the control scheme that affects both the fuzzy soft-sensor and the fuzzy-SPC filter. That is that we are using manipulated variables as sensed variables for the filter and the soft-sensor. This is by necessity, not by choice. We cannot measure the water content or solid content of the feed directly; so we have to estimate them from knowledge of the change in feed rate and the change in heater power requirements. The feed rate and heater power are manipulated variables. Therefore we must keep track of

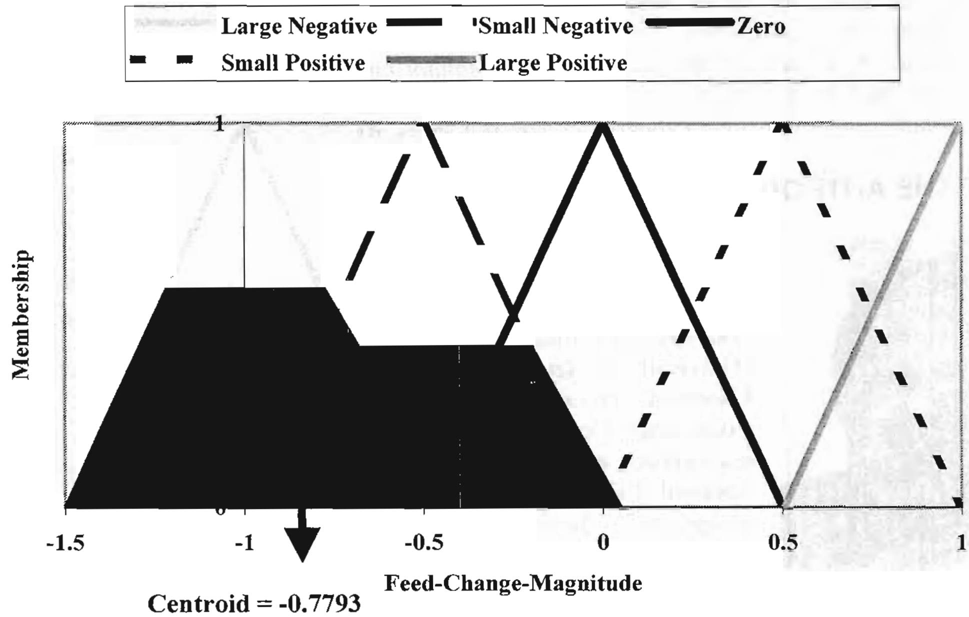

Figure 14. Example output showing the centroid.

our control actions so as not to confuse the changes caused by control with those caused by disturbances or changes in the feed composition. This is the technique that the expert operator has used for years, and we have modeled the expert. The extra effort required to implement the soft-sensor and the filter for this particular control system will not necessarily be required for other control systems.

6. CONCLUSIONS

Other techniques are available for filtering the input and sensor noise. We feel that this technique, which is based upon the principles of statistical process control, is the best for the Centech process and other situations that may be similar. It provides us with a method for withholding a significant process change, unless it is actually needed and provides us with a record of the process feed changes. If the changes are slow enough they can be handled with the feedback system entirely. More abrupt changes will require the feed-forward system intervention. We can also determine changes in sensor noise and hopefully determine in advance if we are having sensor problems, by observing the *Moving Range* chart. The control charts are continually and automatically upgraded during the process operation. This makes the filtering technique flexible and keeps it current. The filter is a rather new addition to our control system. So far it has performed well. Future tests with a wide variety of feedstocks will provide more insight into the true flexibility and usefulness of this method.

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ABOUT THE AUTHORS

W. J. Parkinson has a Ph.D. in Chemical engineering (University of Southern California) and a Ph.D. in Electrical and Computer Engineering (University of New Mexico). Recently retired, he was a team leader for the Chemical Process Development Team in the Applied Engineering Technology Group at Los Alamos National Laboratory. He has 35 years of engineering experience and has spent the last 25 hears at Los Alamos National Laboratory. His engineering experience has been primarily in design, but in the past 16 years he has worked extensively in development of intelligent control systems.

R. E. Smith received a B.S. in Chemical Engineering from Lehigh University in 1986. He obtained his Ph.D. in Chemical Engineering for the University of Wisconsin in 1994. His thesis research concerned the automation of the computer-aided design of control systems through the use of artificial intelligence. He joined Los Alamos National Laboratory in 1994 to work on the design and implementation of a fuzzy logic control system for a three-phase centrifuge for remediation of oil field wastes. He was a co-developer on the R&D 100 Award for the development of the PREDICT methodology.

F. N. Mortensen was educated at the University of New Mexico where he received a BS and MS in Mechanical Engineering and a Ph.D. in Numerical Fluid Mechanics. He came to Los Alamos National Laboratory in October 1972 to work on nuclear weapon design and analysis and high-explosive analysis. He became a Laboratory Fellow in 1992. From 1976 to the present, he has been a staff member and Fellow in the Thermonuclear Design Group. His awards and honors while at the Laboratory include two Distinguished Performance Awards, A LANL Achievement Award, a 1999 R&D 100 Team Award, and seven Nuclear Weapons Technology Recognition of Excellence Awards.

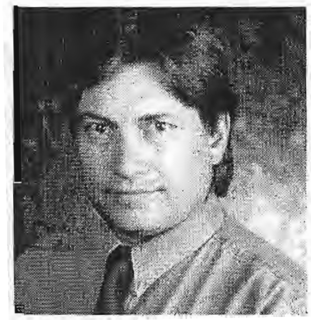
P. J. Wantuck began his career at Los Alamos National Laboratory in 1985 working with the Photochemistry and Photophysics Group on laser-based diagnostic development. Since then he has worked at the Laboratory in a variety of capacities including project leader for the Free Electron Laser Grating Rhomb Program; technical staff member of the Process Development Group; and team leader for the Physical Chemistry/Process Technologies Group. Since 1994, Paul has been the lead manager of the Laboratory's Applied Engineering Technologies Group within the Engineering Sciences

and Applications Division. The group works with a variety of sponsors performing applied R&D in the several areas including thermophysics, robotics, controls, nondestructive testing/evaluation, and process engineering. Paul received his Ph.D. in Engineering Physics in 1985 at the University of Virginia. He also holds an M.E. in Engineering Physics from the University of Virginia and a B.S. in Physics from Union College in Schenectady, NY.

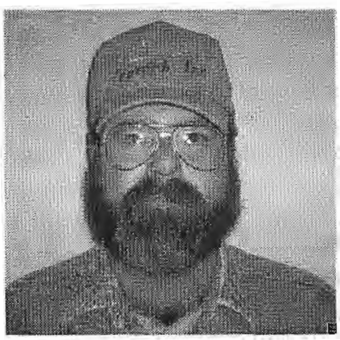
M. Jamshidi (Fellow IEEE, Fellow ASME, Fellow AAAS, Fellow TWAS, Fellow HAE, Fellow NYAS) received the BSEE from Oregon State University in June 1967 and the Ph.D. degree in electrical engineering from the University of Illinois at Urbana-Champaign in February 1971. He holds an honorary doctorate degree from Azerbaijan National University, Baku, Azerbaijan, 1999 and an honorary doctor of engineering for the University of Waterloo, Canada, 2004. Currently, he is the Regents Professor of Electrical and Computer Engineering, the AT&T Professor of Manufacturing Engineering and founding Director of Center for Autonomous Control Engineering - ACE (http://ace.unm.edu) Center and was a co-founder of the PURSUE Program (http://pursue.unm.edu) at the University of New Mexico, Albuquerque, NM, USA. His work on optimal control and optimization of large-scale systems has had a global reach since the early 1980's with the first edition of his seminal book on *Large-Scale Systems – Modeling and Control* in New York. This book and its 1997 edition have been translated into 5 languages and have been adopted in 55 nations. He was a member of the NASA Minority Businesses Resource Advisory Committee (MBRAC), he is a Senior Research Advisor at US Air Force Research Laboratory, KAFB, NM and was a Consultant to Department of Energy's Office of Industrial Technologies on effects of robotic automation on 10 "Industries of the Future". He is also on the USA National Academy of Sciences NRC's pre-doctoral Fellowship Board for Ford Foundation. He was a member of the NASA JPL Surface Systems Track Review Board. He was a member of the advisory committee of NASA JPL's *MARS Pathfinder Project* mission which landed on July 4, 1997. He was on the USA National Academy of Sciences NRC's Integrated Manufacturing Review Board for DOE. Previously he spent 6 years at the US Air Force Research (Weapons or Phillips) Laboratory working on large-scale systems, control of photonics systems and adaptive optics. He has been a consultant with Department of Energy's Los Alamos National Laboratory, Sandia National Laboratories and Oak Ridge National Laboratory. He has worked in various academic and industrial positions at many national and international locations including with IBM and GM Corporations. He has been advisor to 33+ Ph.D. and 42+ M.S. students since 1984. As ACE Center Director, he has lead a large academic team of researchers and educators which has resulted in over 75 MS (65 are ethnic minorities) and 23 Ph.D. (18 are ethnic minorities) graduates in engineering. In 1999 he was a NATO Distinguished Professor of autonomous control of complex systems assigned for a short 3-weeks educational tour in Portugal. He has over 525 technical publications including 53 books and edited volumes. Six of his books have been translated into at least one foreign language. He is the Founding Editor or Co-Founding Editor or Editor-in-Chief of 5 journals (including Elsevier's *International Journal of Computers and Electrical Engineering* 1989-Present), IOS Press's *Intelligent and Fuzzy Systems (1992-2003),* and TSI Press's *Intelligent Automation and Soft Computing, 2002-present,* and one magazine (*IEEE Control Systems Magazine,* 1980-1984). He also has been on the executive editorial boards of a number of journals and two encyclopedias. In 1986 he helped launch a specialized Symposium on robotics, which was expanded to International Symposium on Robotics and Manufacturing (ISRAM) in 1988. In 1994 it was expanded into World Automation Congress (WAC, http://wacong.org) where it now encompasses four symposia and one forum on Robotics, Manufacturing, Automation, Control, Soft Computing, Multimedia, Financial Engineering, Bio-medicine, and Image Processing. He has been the General Chairman of WAC from its inception. He is a co-founder of TSI Enterprise, Inc., a 25-year old NM Corporation specializing in control technologies for complex systems including energy systems, water treatment systems and space robotics, educational tools and publishing.

Dr. Jamshidi is a Fellow of the IEEE, a Fellow of the ASME, Fellow of the American Association for the Advancement of Science (AAAS), an Associate Fellow of Third World Academy of Sciences (Trieste, Italy), Member of Russian Academy of Nonlinear Sciences, Honorary Fellow, Hungarian Academy of Engineering, a fellow of the New York Academy of Sciences and recipient of the IEEE Centennial Medal and IEEE Control Systems Society Distinguished Member Award and the recipient of the IEEE Control

Systems Society Millennium Pin. Currently, he is a Vice-President and member of the Board of Governors of the IEEE Systems, Man and Cybernetics Society. He is an Honorary Professor at three Chinese Universities and is on the Board of Nobel Laureate Glenn T. Seaborg Hall of Science for Native American Youth in the Navajo Nation.



T. Ross is a registered professional engineer with 30 years experience in the fields of computational mechanics, hazard survivability, structural dynamics, structural safety, stochastic processes, risk assessment, and fuzzy systems. He has just been awarded a prestigious J. William Fulbright Fellowship for study during his sabbatical leave at the Department of Civil Engineering, University of Calgary, Alberta, for the 2001-2002 academic year. He has BS, MS and PhD degrees in Civil Engineering from Washington State, Rice and Stanford Universities, respectively. He has been an engineering educator at the University of New Mexico (UNM) since 1987.



N. Miller is president of Centech, Inc., Casper, Wyoming. He developed and patented a mobile three phase centrifuge unit to separate contaminated petroleum products and associated industrial sludge and wastes. Miller is experienced in all oilfield operations from drilling to production as well as various industrial and hazardous waste operations. After ten years in the oilfield, working with solid control, detection and blow out control equipment, the road lead to the development of the Centech three phase centrifuge. For the past 29 years Miller has been operating centrifuges of all types, the three phase centrifuge and process surrounding it has been the major goal of the last 20. After pursuing ventures with several different major corporations the development was funded by Miller and private investors. The centrifuge design and process is a proven technology and will meet the future needs of industries phase separation problems.

***2.** Centrifuge Vapor Emissions Control:*

It is known that during centrifuge processing of fluids hazardous gas vapors may escape from the centrifuge unit into the air. These vapors if not secured pose a negative impact to air quality and personnel working in the treatment area. Additionally, air quality monitoring is an important regulatory requirement and failure to comply with established air quality standards can result in work stoppage by governing environmental agencies. Centech centrifuge inventor assessed this problem and designed a proprietary Centrifuge Gas-Vapor Recovery Unit for recovering gas vapors emitted during the centrifuge process. The vapor recovery unit collects and condenses the gaseous vapors into a collection vessel instead of releasing the pollutant into the air which adds a valuable quality control measure for pollutant vapors during the centrifuge process and ensures compliant to regulatory pollutant standards.

Land treatment units. The rate of emissions from a land treatment unit is directly related to the concentration of hydrocarbons present in the waste, the volatility of the hydrocarbons, the rate of application of the waste, the rate of biodegradation of the waste, and the soil's moisture content. One obvious option for reducing emissions from land treatment units is to decrease the rate at which wastes are applied to the unit and ensure that waste is not applied when wind conditions are likely to increase emissions.

See Attached Documentation:

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611 SKYLINE ROAD, P.O. BOX 4128 • LARAMIE, WYOMING 82071 • (307) 742 0031 • FAX (307) 721-2913

September 7, 1994

Mr. Neal Miller
Centech
920 Lake View Lane
Casper, WY 82604

Dear Neal:

As we have discussed previously, the concentrations of aromatic hydrocarbons from the Centech unit are unacceptably high. An air sample collected with the photoionization detector (PID) on July 26, 1994, yielded a total volatile organic carbon reading of 695 ppm. The subsequent laboratory analysis of this sample showed 150 mg/m^3 of benzene, 520 mg/m^3 of ethylbenzene, 220 mg/m^3 of m,p-xylene, 60 mg/m^3 of o-xylene, and 350 mg/m^3 of toluene. These concentrations are well above the permissible exposure limits.

Efforts to control these vapors have not yet yielded satisfactory results. Measurements taken with the PID in the vicinity of the Centech unit on August 23, 1994, produced values as high as 309 ppm.

Because these vapors could pose a health threat to all workers in the area, it is necessary to eliminate the exposure. Accordingly, we require that vapors be reduced to 50 ppm or less by 8:00 a.m. on Monday, September 12, 1994. If vapors exceed 50 ppm, as measured on the PID, Centech operations will be halted. Processing will not be allowed in the Centech unit until the vapors have been controlled.

Once vapors are reduced to or below 50 ppm, another air sample will be collected and sent to the laboratory for analysis.

Sincerely,

Jim Sherman

Jim Sherman
Site Superintendent

JS/jb
File: 93-079-A

OTHER LOCATIONS

1949 SUGARLAND DRIVE, SUITE 134
SHERIDAN, WYOMING 82801
(307) 672-0761
FAX (307) 674-4265

701 ANTLER DRIVE, SUITE 233
CASPER, WY 82601
(307) 473-2707
FAX (307) 237-0828

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611 SKYLINE ROAD, P.O. BOX 4128 • LARAMIE, WYOMING 82071 • (307) 742-0031 • FAX (307) 721-2913

February 22, 1995

Neal Miller
Centech
920 Lake View Lane
Casper, WY 82604

Dear Neal:

We have received results from the air monitoring performed in and near the Centech unit. Real-time measurements with the photoionization detector (PID) indicated the presence of organic vapors. Passive absorbers (3-M badges) were therefore placed in the area surrounding the Centech unit on February 7, 1995, to collect samples that would enable us to identify the components of these vapors.

The time-weighted average (TWA) measured for benzene was 0.38 ppm near the ceiling inside the button house. The TWA for benzene was 0.48 ppm on the south wall, inside the tent, across the walkway from the vat. The 8-hour permissible exposure limit (PEL) for benzene is 1 ppm; the action level is 0.5. Fortunately, we are under the limits in both cases. However, the values are close enough to warrant caution. I urge the field workers to continue to minimize their time near the vapors.

Toluene, ethylbenzene, and xylene were measured at slightly higher levels than benzene. However, the PELs for these compounds are 100 ppm, so we are far below the standards in these cases.

Our monitoring showed that conditions are highly variable. In most instances, I cannot even get a reading on the PID inside the button house. On this particular day, the instrument was reading up to 188 ppm of total organic vapors.

Centech is in the process of installing an improved vapor control system.

OTHER LOCATIONS

1949 SUGARLAND DRIVE, SUITE 134
SHERIDAN, WYOMING 82801
(307) 672-0761
FAX (307) 674-4265

701 ANTLER DRIVE, SUITE 233
CASPER, WY 82601
(307) 473-2707
FAX (307) 237-0828

I have attached a copy of the laboratory report. Please feel free to call me if you have any questions.

Sincerely yours,

Florence P. Barker

Florence P. Barker
Health & Safety Officer

FB:sb
cc: File 93-079-A
All technical committee members
Field Office

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611 SKYLINE ROAD, P.O. BOX 4128 • LARAMIE, WYOMING 82071 • (307) 742-0031 • FAX (307) 721-2913

October 31, 1995

Neal Miller
Centech
920 Lake View Lane
Casper, Wyoming 82604

Dear Mr. Miller:

We have received results from the air monitoring performed in and near the Centech unit on September 9, 1995. An active pump was used to collect two samples. In the first case it was worn by a Centech employee during performance of his duties. In the second it was used to collect a sample in the button house. The samples were analyzed for benzene, ethyl benzene, toluene, and xylene.

The analytical results for both samples reveal that all four chemicals were below detection limits.

I attach a copy of the laboratory report. Please feel free to call me if you have any questions.

Sincerely,

Florence P. Barker

Florence P. Barker
Health & Safety Officer

FPB:gh
Enclosure
XC: File 93-079-A
All technical committee members
Field Office

REPORT OF LABORATORY ANALYSIS

PACE INCORPORATED
THE ASSURANCE OF QUALITY

Western Water Consultants
611 Skyline Road
Laramie, WY 82070

Client Account Number: 17645
Service Order #: 0000-4358
PACE Project ID: D50210.300

Attn:
Re: IH ANALYSIS (BTEX)

Report Date : February 16, 1995

Laboratory Sample # / Analyte	Client Sample #	Det.Lim.	Volume/Time Unit	Main	Backup	Total	Air Concentration ppm	mg/M3
65-536052.2	**EY9473C**		440 minutes					
Benzene		0.001	mg			0.019	0.38	
Toluene		0.01	mg			0.08	2	
Ethyl Benzene		0.01	mg			0.03	0.6	
Xylene		0.01	mg			0.15	2.9	
65-536051.9	**EZ0388C**		440 minutes					
Benzene		0.001	mg			0.024	0.48	
Toluene		0.01	mg			0.10	1.9	
Ethyl Benzene		0.01	mg			0.03	0.6	
Xylene		0.01	mg			0.18	3.5	

5930 McIntyre Street
Golden, CO 80403
TEL: 303-278-3400
FAX: 303-278-2121

pace INCORPORATED
ENVIRONMENTAL LABORATORIES

REPORT OF LABORATORY ANALYSIS

Western Water Consultants
611 Skyline Road
Laramie, WY 82070

Client Account Number: 17645
Service Order #: 0000-5965
PACE Project ID: D50921.301

Attn:
Re: 93079

Report Date : October 3, 1995

Laboratory Sample # / Client Sample # / Analyte	Det.Lim.	Volume/Time Unit	Main	Backup	Total	Air Concentration ppm	mg/M3
65-545270.5 #1-PERSONAL		30.00 Liters					
Benzene	0.001	mg	LT 0.001	LT 0.001	LT 0.001	LT 0.010	
Toluene	0.01	mg	LT 0.01	LT 0.01	LT 0.01	LT 0.088	
Ethyl Benzene	0.01	mg	LT 0.01	LT 0.01	LT 0.01	LT 0.077	
Xylene	0.01	mg	LT 0.01	LT 0.01	LT 0.01	LT 0.077	
65-545271.8 #2-BUTTONHOUSE		18.00 Liters					
Benzene	0.001	mg	LT 0.001	LT 0.001	LT 0.001	LT 0.017	
Toluene	0.01	mg	LT 0.01	LT 0.01	LT 0.01	LT 0.15	
Ethyl Benzene	0.01	mg	LT 0.01	LT 0.01	LT 0.01	LT 0.13	
Xylene	0.01	mg	LT 0.01	LT 0.01	LT 0.01	LT 0.13	

Analyzed 09/26/95.

5930 McIntryre Street
Golden, CO 80403
TEL: 303-278-3400
FAX: 303-278-2121

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611 SKYLINE ROAD, P.O. BOX 4128 • LARAMIE, WYOMING 82071 • (307) 742-0031 • FAX (307) 721-2913

November 21, 1995

Mr. Neal Miller
Centech
920 Lake View Lane
Casper, WY 82604

Dear Neal:

You asked for permission to use the monitoring data we collected at the Powder River Crude Processors site. Certainly, you may use this information. It is essential to remember, however, that each bit of monitoring data represents the air quality at *that* time and place, under *those* climatic conditions, under *those* processing conditions for *that* fluid. In other words, the analytical results were time/site/condition-specific. Although these data might contribute to a general understanding of air quality in and near the Centech unit, they cannot be used to draw conclusions about worker exposure during other operations.

Please feel free to call if I can be of any help. I am glad to have been a part of this project and hope that there will be future opportunities to work with you.

Best wishes,

Florence

Florence P. Barker
Health & Safety Officer

FPB:sb
File: 93-079-L